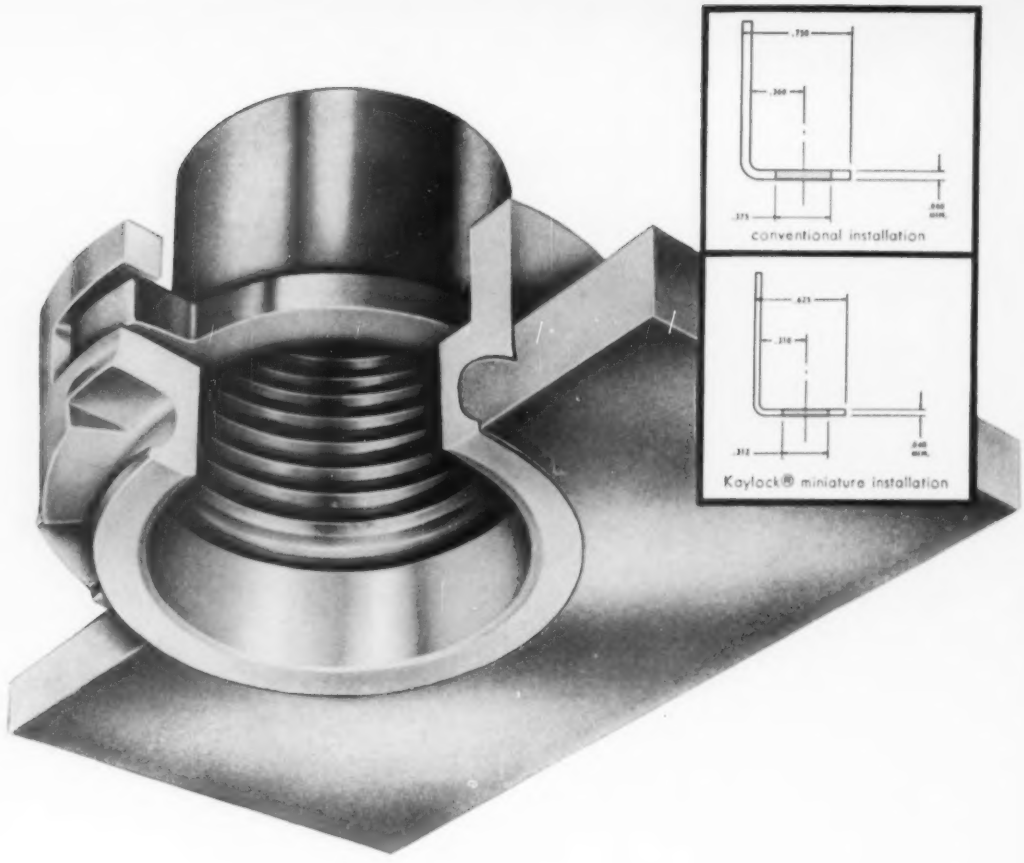
Aviation Week and Space Technology

November 7, 1960

SPECIAL REPORT:

Transit IIIA Navigation-Aid Satellite

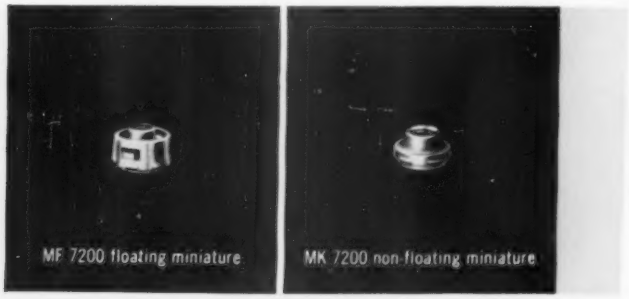
Sikorsky HSS-2
ASW Helicopters



No mistaking Kaynar's new stake nut—it's miniaturized

The new Kaylock® Miniature Stake Nuts bear the unmistakable mark of Kaynar's leadership in aerospace fastener weight and space savings. These new miniatures answer the critical need for installed reliability of threaded elements in minimum thickness materials...can save you up to 33% of hardware weight. Additional savings can accrue as a result of thinner parent material requirements (.030 minimum thickness for Kaylock Non-Floating Stake Nuts, .040 minimum for Floating Stake Nuts.)

Easier and Quicker to Install. No flaring of the nut shank is required. The pressure used in installation results in a cold flow of the parent material. This interlock of the nut and the mating material, in a smaller installation hole, provides greater structural integrity. Staking action of the Kaylock self-locking nut provides maximum retention against push-out and torque-out. The new series is available in miniature and regular configurations, both floating and non-floating. *Write today* for the new *Kaylock Stake Nut Brochure,* or contact your Kaynar representative.

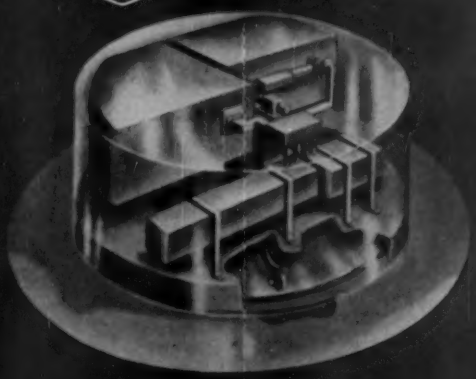


Kaylock®
first in lightweight locknuts

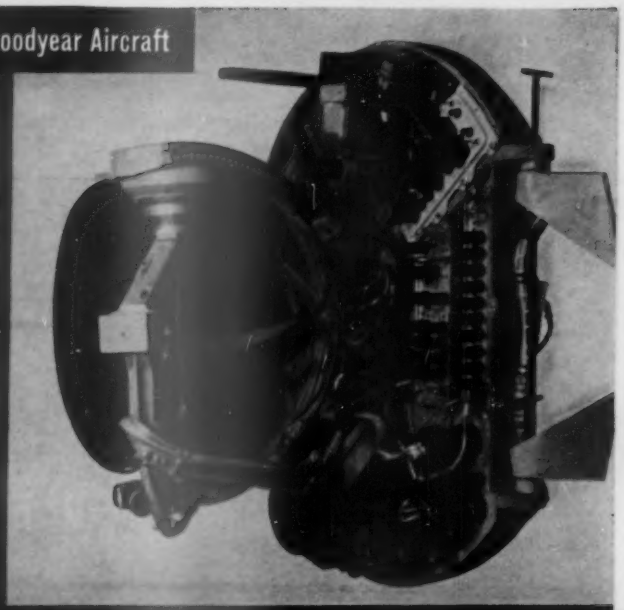
KAYNAR MFG. CO., INC., KAYLOCK DIVISION
Box 2001, Terminal Annex, Los Angeles 54, Calif. Branch offices, warehouses & representatives in Wichita, Kan.; New York, N.Y.; Atlanta, Ga.; Renton, Wash.; Montreal; Paris; London; The Hague

AIRBORNE RADAR: another prime capability of Goodyear Aircraft

GOODYEAR



1. **New surface-wave Luneberg lens concept** for 1-inch-thick antenna provides 360° look in single sweep.



2. **PINPOINT radar guidance system** employs programmed data stored on film to guide missiles or aircraft to target.

3. **Shaped beam reflector and line feed** for high-altitude radar studies. System provides excellent pictures from 100,000 feet and higher.

"ROVING REPORTERS" with no strings attached!

Here's airborne radar with a sense of responsibility—developed by GAC for *unattended operation.* Lightweight and compact, this GAC equipment is transistorized and miniaturized to stow away handily in missiles, drones, balloons, as well as manned aircraft. Unlike attended radar, these "no-hands" radars provide presentations that are more reliably interpreted—they're not colored by an operator's subjective observations. With each component built to optimum reliability level, GAC's airborne radars are geared to operate for long periods in any weather without requiring adjustment. GAC has the specialized skills to meet your radar needs—whether for accurate guidance, reconnaissance or surveillance. For proof, write Goodyear Aircraft Corporation, Dept. 916AW, Akron 15, Ohio.

Lots of good things come from

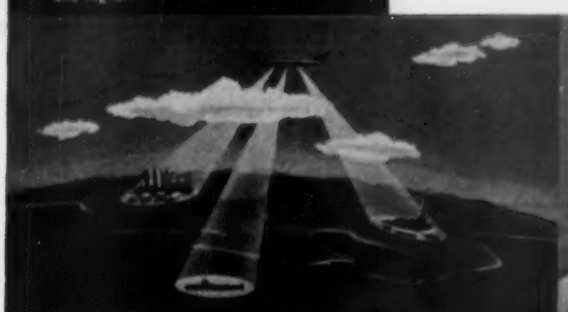
GOODYEAR AIRCRAFT

Plants in Litchfield Park, Arizona, and Akron, Ohio

Pinpoint—T. M. Goodyear Aircraft Corporation, Akron 15, Ohio

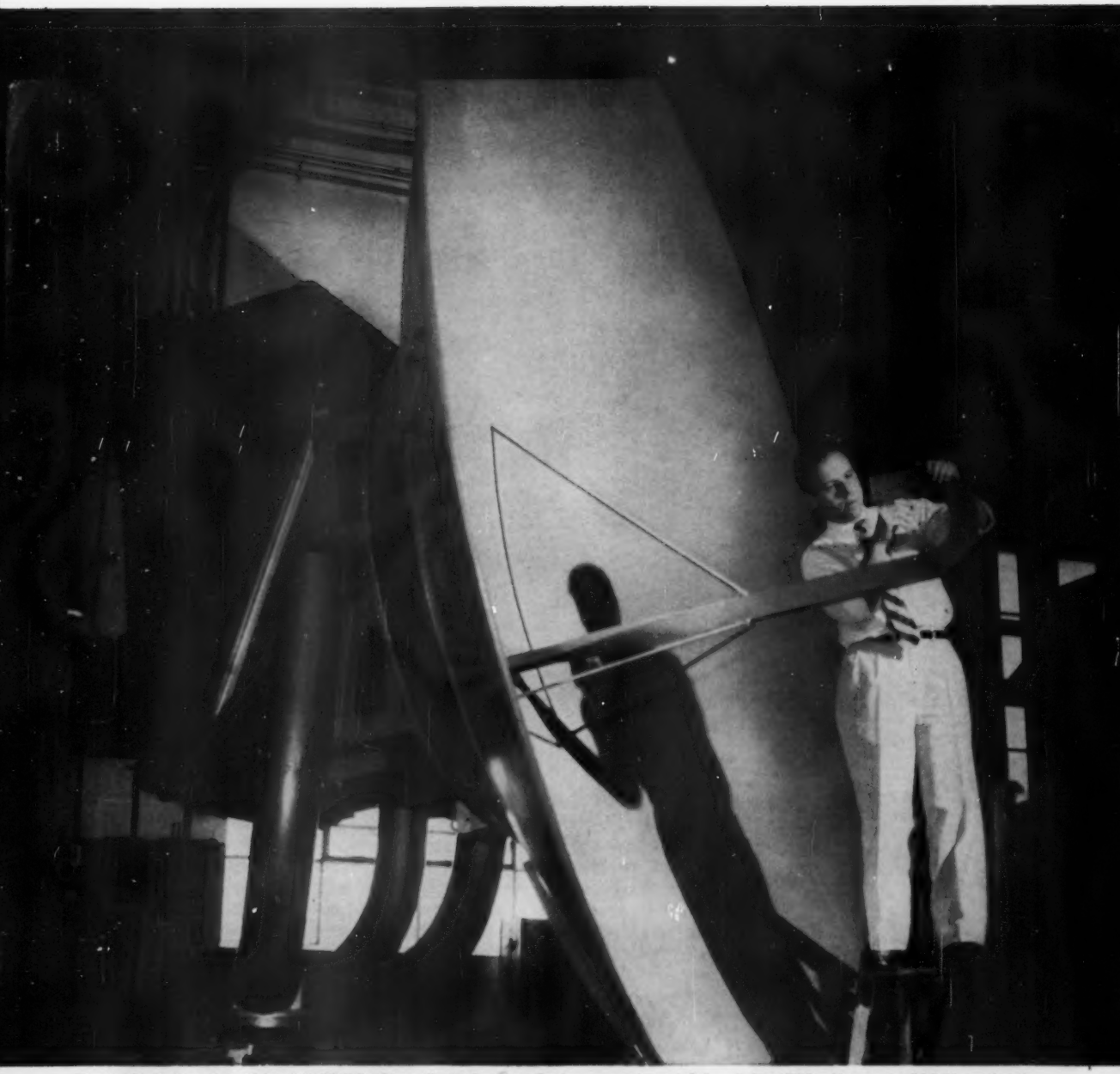
Providing all 3 weapon system skills

MANUFACTURE



4. **High-resolution radar** sees and records, through continuous radar photography, distant areas or inaccessible territory.

5. **Large slip-ring assembly** built by GAC.



Twelve-foot diameter dish of WSR-57 "Stormfinder" radar. System operates at S band, has 250-mile range, 500 Kw output

Now being delivered to the U. S. Weather Bureau are WSR-57 weather detection radars. Each unit covers 200,000 square miles, tracks storms, identifies rain, snow and fog. This equipment is designed and produced by Raytheon.

RAYTHEON COMPANY, WALTHAM, MASS.

RAYTHEON

EXCELLENCE IN ELECTRONICS

AVIATION CALENDAR

Nov. 14-15—Quarterly Regional Meeting, Assn. of Local Transport Airlines, Olympic Hotel, Seattle, Wash.

Nov. 14-16—National Convention, National Aeronautics Assn., Indio, Calif.

Nov. 14-17—Sixth Annual Conference on Magnetism and Magnetic Materials, New Yorker Hotel, New York, N. Y.

Nov. 14-18—Flight Safety Foundation's 13th Annual International Air Safety Seminar, in cooperation with Aviation Crash Injury Research, Phoenix, Ariz.

Nov. 14-18—Western Engineering Conference and Exhibit, American Society of Tool and Manufacturing Engineers, Memorial Sports Arena, Los Angeles, Calif.

Nov. 14-19—Annual Convention, Air Line Pilots Assn., Carillon Hotel, Miami Beach, Fla.

Nov. 15-16—Symposium on Engineering Application of Probability and Random Function Theory, Purdue University, Lafayette, Ind.

Nov. 15-16—12th Annual Mid-America Electronics Conference, Institute of Radio Engineers, Hotel Muehlebach, Kansas City, Mo.

Nov. 15-17—36th Meeting, Aviation Distributors and Manufacturers Assn., Riviera Hotel, Palm Springs, Calif.

Nov. 15-17—Air Force-Navy-Industry Propulsion Systems Lubricants Conference (unclassified), Hilton Hotel, San Antonio.

Nov. 15-18—Annual Meeting, Executive Board of the Flight Engineers International Assn. (AFL-CIO), Sheraton-Atlantic Hotel, New York, N. Y.

Nov. 29—General Freight Traffic Management Seminar for Army, Navy, Air Force and Marine Corps transportation personnel of the Southwestern Traffic Region, Adolphus Hotel, Dallas, Tex.

(Continued on page 6)

AVIATION WEEK and Space Technology

November 7, 1960

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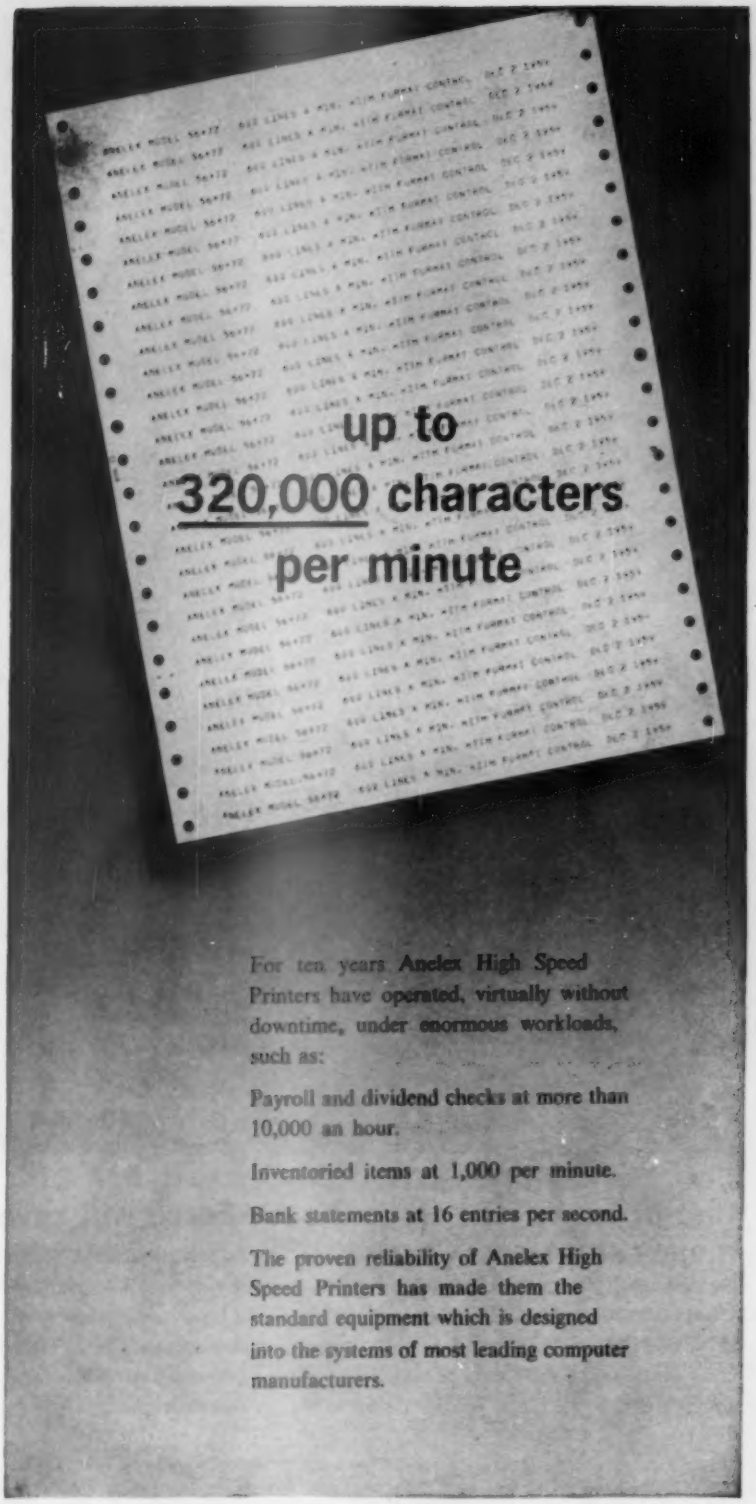

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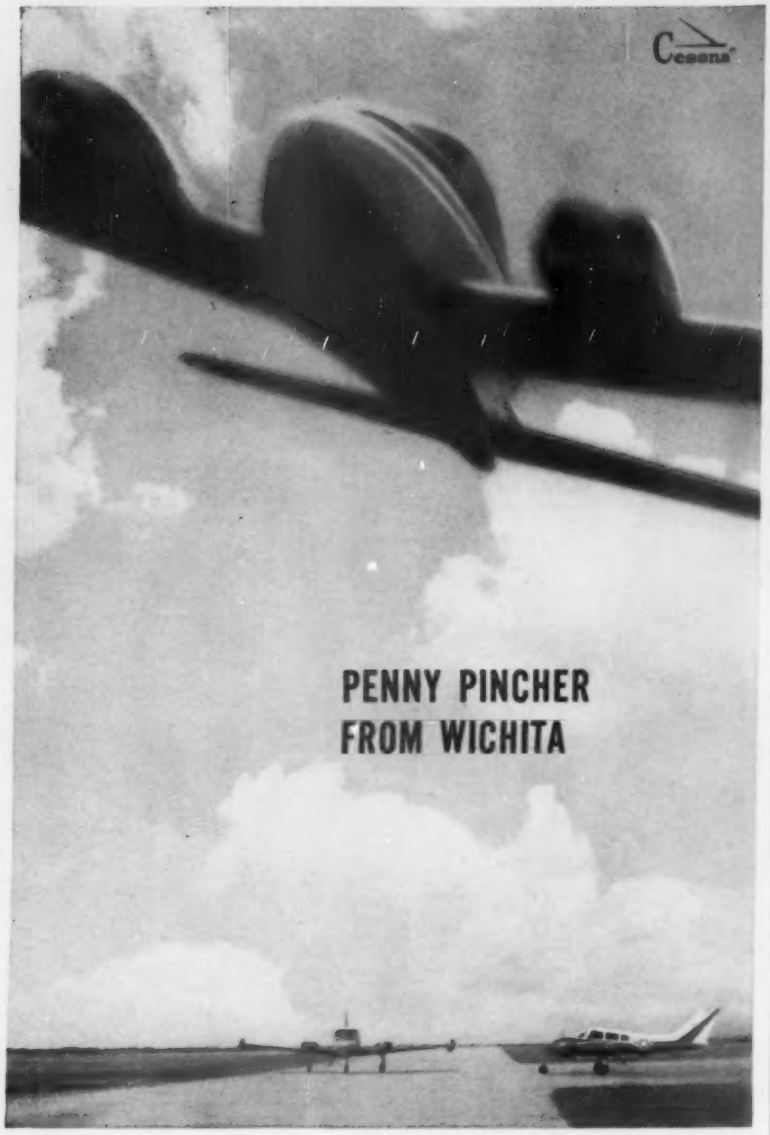

One of many new ways the Air Force will save money this year: Cessna U-3B To join the Air Force soon, the new utility transport U-3B has a proud heritage to live up to. In 3½ years with USAF, its predecessor, U-3A, has become known for its businesslike practicality—in moving personnel swiftly, easily, on little notice. And even more, for its highest in-commission rate and lowest operating cost of any plane in the Air Force today. Job of the new U-3B: not just to live up to the heritage, but to improve on it.

CESSNA
Military Division
WICHITA, KANSAS

World's most experienced makers of utility military aircraft

AVIATION CALENDAR

(Continued from page 5)

Dec. 5-8—15th Annual Meeting and Astronautical Exposition, American Rocket Society, Shoreham Hotel, Washington, D. C.

Dec. 6-8—Annual Meeting, National Aviation Trades Assn., Oklahoma-Biltmore, Oklahoma City, Okla.

Dec. 12-15—Atomic Industry Exhibition, California Masonic Memorial Temple, San Francisco, Calif., concurrent with the Atomic Industrial Forum's Annual Conference (Fairmont Hotel) and the American Nuclear Society's Winter Meeting (Hotel Mark Hopkins).

Dec. 13-15—Tenth Annual Eastern Joint Computer Conference, Hotel New Yorker and Manhattan Center, New York, N. Y.

Dec. 17—24th Wright Brothers Lecture, Natural History Bldg., Smithsonian Institution, Washington, D. C.

Dec. 26-31—127th Meeting, American Association for the Advancement of Science, New York, N. Y.

Dec. 28-30—Seventh King Orange International Model Plane Meet, Miami, Fla.

Jan. 9-11—Seventh National Symposium on Reliability and Quality Control, Bellevue-Stratford Hotel, Philadelphia, Pa.

Jan. 9-13—International Congress and Exposition, Society of Automotive Engineers, Cobo Hall, Detroit, Mich.

Jan. 16-18—Seventh Annual National Meeting, American Astronautical Society, Dallas, Tex.

Jan. 23-25—29th Annual Meeting, Institute of the Aeronautical Sciences, Hotel Astor, New York, N. Y. Honors Night Dinner, Jan. 24.

Feb. 1-3—Second Winter Military Electronics Convention, Institute of Radio Engineers, Biltmore Hotel, Los Angeles.

Feb. 1-3—Solid Propellants Conference, American Rocket Society, Salt Lake City.

Feb. 15-17—International Solid-State Circuits Conference, Institute of Radio Engineers, University of Pennsylvania campus and Sheraton Hotel, Philadelphia.

Mar. 5-9—Sixth Annual Gas Turbine Conference and Exhibit, American Society of Mechanical Engineers, Shoreham Hotel, Washington, D. C.

Mar. 9-10—Second Symposium on Engineering Aspects of Magnetohydrodynamics, University of Pennsylvania, Philadelphia.

Mar. 9-10—Flight Propulsion Meeting, Institute of the Aeronautical Sciences, Cleveland, Ohio (classified).

Mar. 12-16—Aviation Conference, American Society of Mechanical Engineers, Statler-Hilton, Los Angeles, Calif.

Mar. 13-15—Flight Testing Conference, American Rocket Society, Los Angeles.

Mar. 13-16—Test, Operations and Support Conference, American Rocket Society, Biltmore Hotel, Los Angeles, Calif.

Mar. 16-18—Fifth National Conference on Aviation Education, Mayflower Hotel, Washington, D. C.

Mar. 20-23—International Convention, Institute of Radio Engineers, Coliseum and Waldorf Astoria Hotel, New York, N. Y.

Apr. 5-7—Lifting Re-Entry Vehicles: Structures, Materials & Design, American Rocket Society, Palm Springs, Calif.

May 26-June 4—24th French International Air Show, Le Bourget, Paris, France.

Raytheon's Advanced Systems for Mauler...
Operational in ANY Mobile Surface Environment

Mauler is the United States Army's new automatic-firing air defense system under development by Convair/Pomona, Convair Division of General Dynamics Corporation. It will be highly mobile and will track targets and launch missiles on the run from virtually any position.

Raytheon provides the Mauler System's self-contained Detection and Fire Control Radars. These radars are capable of directing missiles against multiple targets and of fast redirection of fire. Raytheon also supplies Mauler's Acquisition Radar and Target Data Processing Components. For these systems and components, Raytheon has developed advanced miniaturization techniques.

Mauler radars are the most recent example of Raytheon reliability in extreme environments. They are an outgrowth of Raytheon pioneering in the development of detection and fire control radars for the Sparrow, Hawk, and Tartar weapons systems.

For any mobile surface requirement, Raytheon offers proven capability in design, development and manufacture of reliable radar systems.

For complete information, write: DIRECTOR OF MARKETING, Equipment Division, Dept. M-1, Raytheon Company, West Newton, Massachusetts

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EQUIPMENT DIVISION

RAYTHEON

Progress in Systems packaging... for the Missile Age

CRAIG ENGINEERS HEAD UP THE MOST COMPLETE SYSTEMS PACKAGING SERVICE YOU'LL FIND...

Dip into this versatile brainpower pool . . . and you'll come up with the answers to virtually any problem in systems packaging.

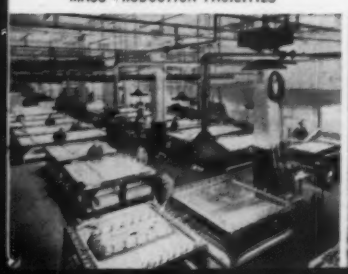
Example: a problem in housing mobile systems? Ask our production specialists. Their principal responsibility: development of light weight, high strength aluminum shelters, vans and trailers (like our famed Helicop-Hut, for instance) for mobile air transportable ground support electronic systems.

Example: a problem in components for mobile systems? Our men in this department specialize in such hardware as telescoping antenna masts, transit cases, spare parts boxes, equipment racks or cabinets, or you name it.

Example: a problem in systems installation? The service: layout and installation of complete systems, through final check-out for maximum mobility and reliability, including all cabling, shock and vibration isolation, human engineering, environmental control and testing.

Example: a problem in systems reliability? Testing is a speciality at Craig. In addition to regular testing techniques and procedures, special tests are developed to insure equipment reliability, supported by complete and accurate test data of all kinds.

MASS PRODUCTION FACILITIES



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TESTING: DEEP WATER FLOTATION

TESTING: THERMAL SHOCK CHAMBER

..TAKES A VERY SPECIAL KIND OF "WHEEL"

Example: a problem in fabrication . . . or research? Craig's engineering design and development staff will work on it. Staff also provides a highly unique "fabrication research" service. Their work with aluminum, foamed plastic, and epoxy adhesives for lightest weight and highest strength may well prove helpful.

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Craig's capabilities brochure will be sent on request. Write to Dept. A-6.

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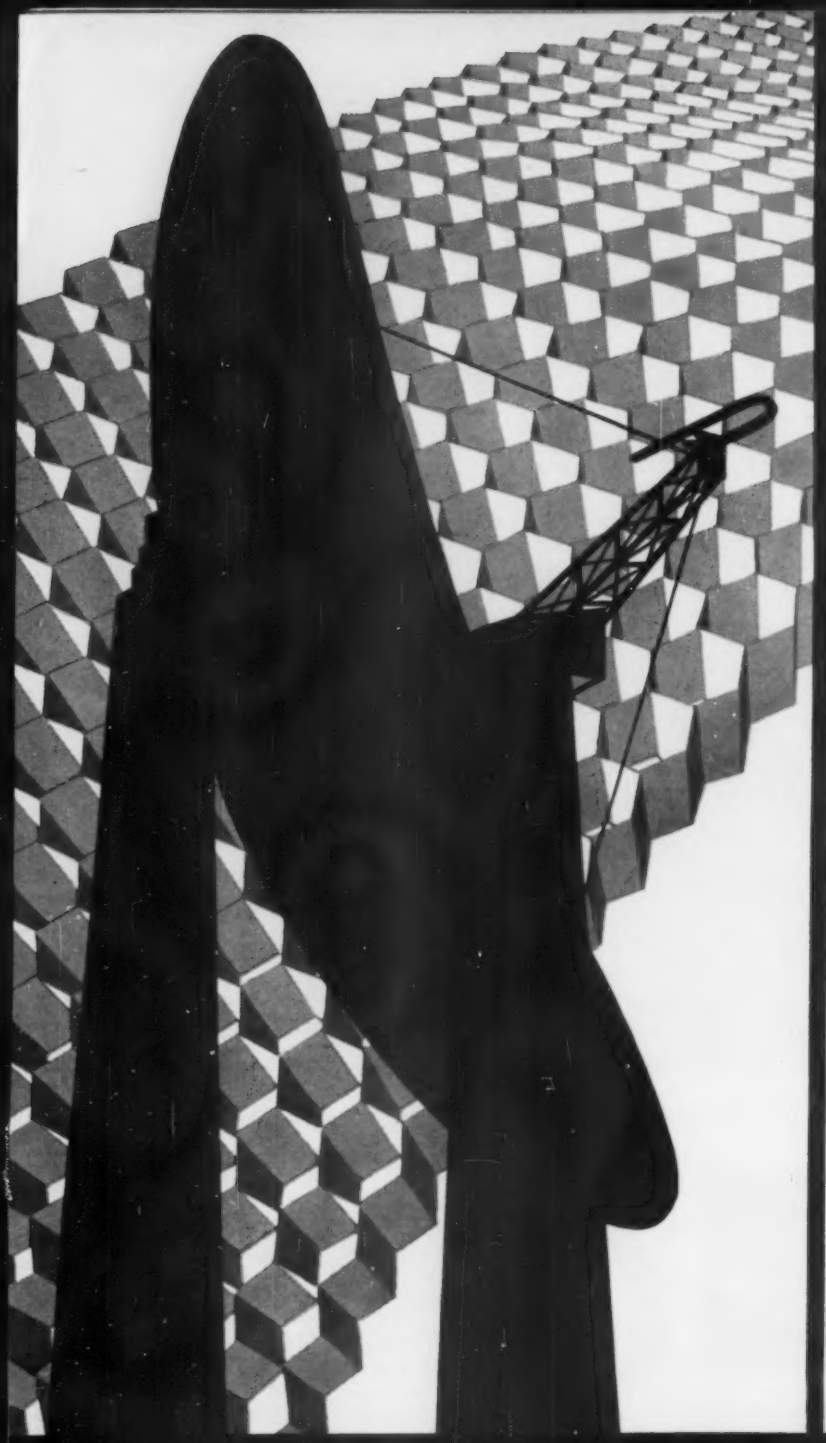

Three stories high.. the FPS-26 tells a story of Avco/Nashville radar capability

Now in production at Avco/Nashville is a huge reflector for the Air Force's FPS-26 height-finder radar. Researched and developed by Avco's Electronics and Ordnance Division, the entire FPS-26 stands three stories high. The reflector, made of high-rigidity, low-weight honeycomb sandwich construction, is housed in a radome 50 feet in diameter.

In contrast is another radar reflector also made by Avco/Nashville. It is a small, highly developed, carefully finished reflector for Mach 3 military aircraft. It is made of *Avcomb* stainless steel honeycomb.

These two reflectors indicate the range and scope of Avco/Nashville's capabilities in the field of radar reflectors as well as other structures with high-strength, lightweight materials.

In its large plant in Nashville, Tennessee, Avco/Nashville has specialists experienced in the design, tooling, and construction of radar antennas or reflectors. It also has facilities for producing pedestals for large radars.

Conventional radar antennas and those of sandwich construction are all within the demonstrated engineering and production capability of Avco/Nashville.

Inquiries about radar structures are invited from prime contractors. Write to: General Marketing Manager, Nashville Division, Avco Corp., Nashville, Tenn.

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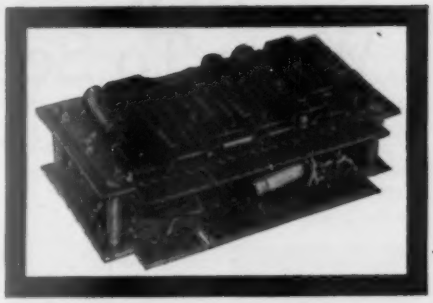
TAPCO ANALOG COMPONENTS

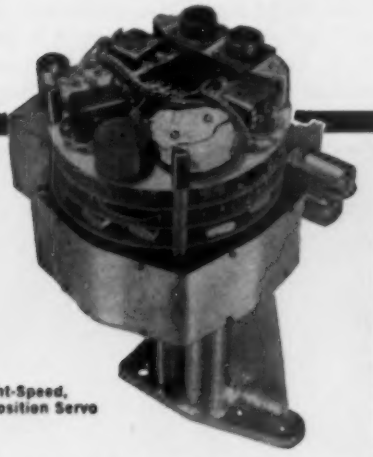
For airborne equipment

TAPCO analog components have been proved in various classified aircraft and missile applications. The TAPCO line includes:

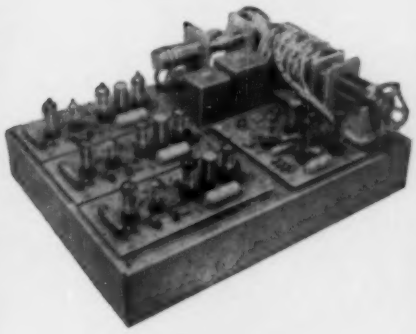
- Position Servos
- Velocity Servos
- Miniaturized Servo Amplifiers
- Tracking Computers
- Data Conversion Units
- Arithmetic Computers



Transistorized Servo Amplifier



Eight-Speed, Eight-Position Servo



Computer Servo Chassis

PERFORMANCE DATA: TRANSISTORIZED EIGHT-SPEED SERVO (Illustrated at left)—**Speed Range:** From 1 to 2.5 rpm. **Speed Tolerance:** ±0.2% over temperature range of 50°F to 85°F. **Angular Vibration Tolerance:** 5 x 10^{-5} radians double amplitude. **Acceleration:** Zero to maximum speed within 0.2 seconds. **Transition time:** Speed change time within 0.1 seconds. **Torque Output:** 100 oz. in. with 15 watts input. Higher torque available with increased power consumption. **Power Requirements:** 10.0 watts steady rate. 18 watts peak during acceleration or speed change. **PHYSICAL DATA—Size:** 10¾" x 7¾" x 8½". **Weight:** 5¼ lbs.

For ground support equipment

All TAPCO GSE analog computer components use MIL-approved parts for highest reliability. Modular construction of these components allows compact assembly on chassis. The TAPCO line includes: DC Operational Amplifiers, Servo Amplifiers, Buffer Amplifiers, Electronic Modulators, Position and Rate Servos, Vector Servos, Aircraft Dynamic Simulator, Coordinate Converters, Special Multipliers and Dividers, Ballistic Computer.

PERFORMANCE DATA: DC OPERATIONAL AMPLIFIER—Gain: 10^6 open loop at 0.01 cps. **Drift:** Less than 100 micro-volts. **Linearity:** ±.1% of input voltage. **Input Power:** 25 watts. **Output Voltage:** ±85 V DC—50K Load, ±40 V DC—8K Load. **Noise:** Less than 100 micro-volts. **PHYSICAL DATA—Size:** 4" x 8⅜" x 2½". **Weight:** 9 oz.

PERFORMANCE DATA: AC SERVO AMPLIFIER—Gain: Open loop 60,000. **Gain:** With external feedback 10,000. **Input Impedance:** Greater than 1 megohm. **Frequency Response:** To 40 cycles. **Input Power:** Approx. 40 watts. **Output Power:** Approx. 6 watts. **High Impedance Servo Motor Output. PHYSICAL DATA: Size:** 5" x 7" x 3⅜". **Weight:** 11 oz.

For further information, write on your company letterhead to:

TAPCO GROUP EXPORT REPRESENTATIVE:
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New Ways To See Fire . . .

Fenwal has developed two advanced methods of finding fire or overheat faster in aircraft and missiles.

Fenwal's FIDO (Fire Inspection Device Optical) permits a pilot to *visually* monitor potential danger areas from a remotely located control panel. He merely looks into a tube containing FIDO's optically oriented glass fibers to *see* the hidden area. Or, FIDO can be used by launching crews to check out blind areas in missiles and rockets. *Image resolution is as fine as use demands!*

Fenwal's Surveillance Detector sees fire or overheat that may occur in large volumes, eliminating the "misses" that may be present when point or line detection is used. It operates photoelectrically and is sensitive either to the first flicker of a flame or to heat radiation. It is "blind" to daylight and even the direct rays of the sun — *it "sees" only the potential danger!*

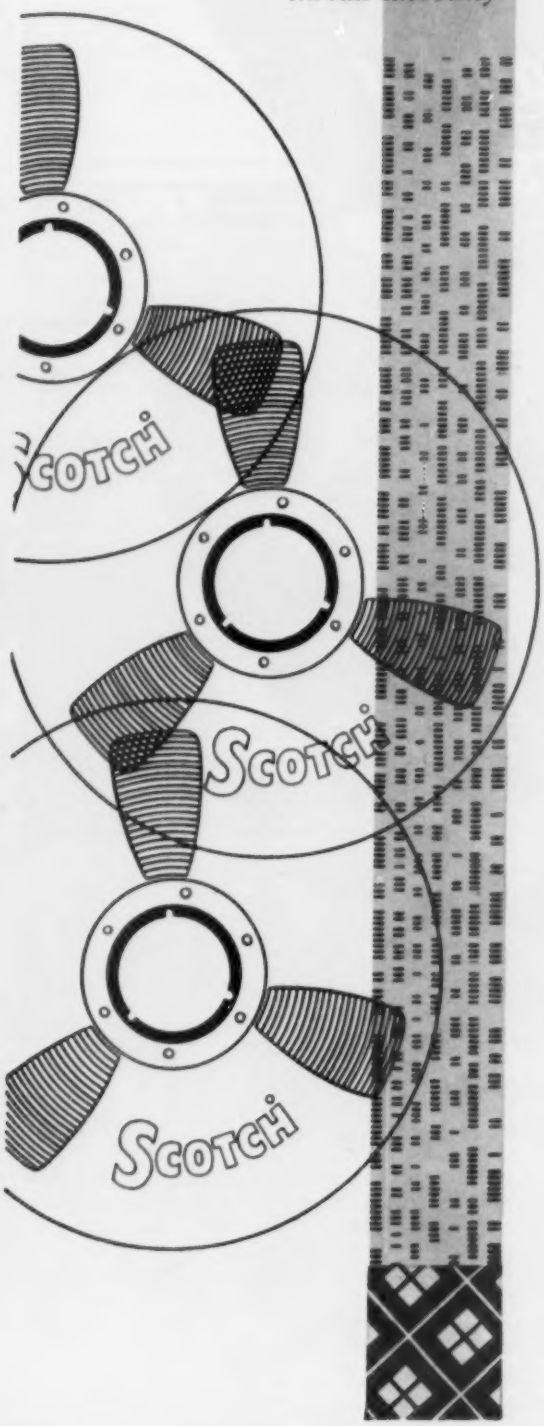
These advanced Fenwal safety devices are the end products of long and continuing research. They complement Fenwal's established capabilities in unit and continuous detectors, and explosion suppression. A Fenwal engineer will gladly supply details. FENWAL INCORPORATED, 1211 Pleasant Street, Ashland, Massachusetts.

Another example of how

Fenwal DETECTS TEMPERATURE . . . PRECISELY

NO DISTORTION OF THE FACTS

"SCOTCH" BRAND Precision Reels stack up well, thread smoothly



IN INSTRUMENTATION, it nearly goes without saying that your choice of reels is as important as your choice of magnetic tapes. You can't afford any distortion of the facts you deal with—so why not give your "SCOTCH" BRAND Tape the best running mate—a "SCOTCH" BRAND Precision Reel.

While most drop outs come from dust or other contaminants on the tape surface, the next most significant factor is related to improper handling. Dents or creases in the tape backing, damage to tape edges caused by uneven winding, too much tension on the tape at the end of a pass—all of these affect performance. Any stresses which exceed the yield point of the tape can cause a permanent set—a physical distortion which in turn leads to the attenuation or loss of important signals.

Precision is no empty word when applied to the "SCOTCH" BRAND reel. Every detail—design, materials and production techniques – grows out of years of careful research and testing by the same 3M research teams who have continually led in the development of magnetic tapes.

The "SCOTCH" BRAND Precision Reel is machined of aluminum. Its unique design offers maximum protection against tape damage from handling, while greatly lowering the moment of inertia—exerting less stress in stops and starts. Because the flanges are precision machined, they can be held to a fine tolerance—thicker at the hub, thinner toward the rim. These closely spaced, tapered flanges guide the tape into a smooth, even stack. Tape edges are kept perfectly aligned.

Threading up is easy on you and the tape. The "SCOTCH" BRAND reel employs a precision ground neoprene ring instead of a threading slot which can cause distortion of the inner turns of tape. To thread up, you simply start a turn of tape on the take-up reel. The neoprene ring, moreover, acts as a cushion for the innermost tape layers and guards against distortion from winding pressure and expansion-contraction stresses.

Flange apertures are reduced to the minimum compatible with the need for observation and threading—giving further protection to tape and greater rigidity to the reel. Compare—as the moment of reel decision approaches, a look at all the facts should lead you to come out in favor of "SCOTCH" BRAND Precision Reels.

Your 3M Representative is close at hand in all major cities—a convenient source of supply and information. For details on reels and tape constructions, consult him or write Magnetic Products Division, 3M Co., St. Paul 6, Minnesota.

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SCOTCH BRAND MAGNETIC TAPE

FOR INSTRUMENTATION

MINNESOTA MINING AND MANUFACTURING COMPANY
...WHERE RESEARCH IS THE KEY TO TOMORROW

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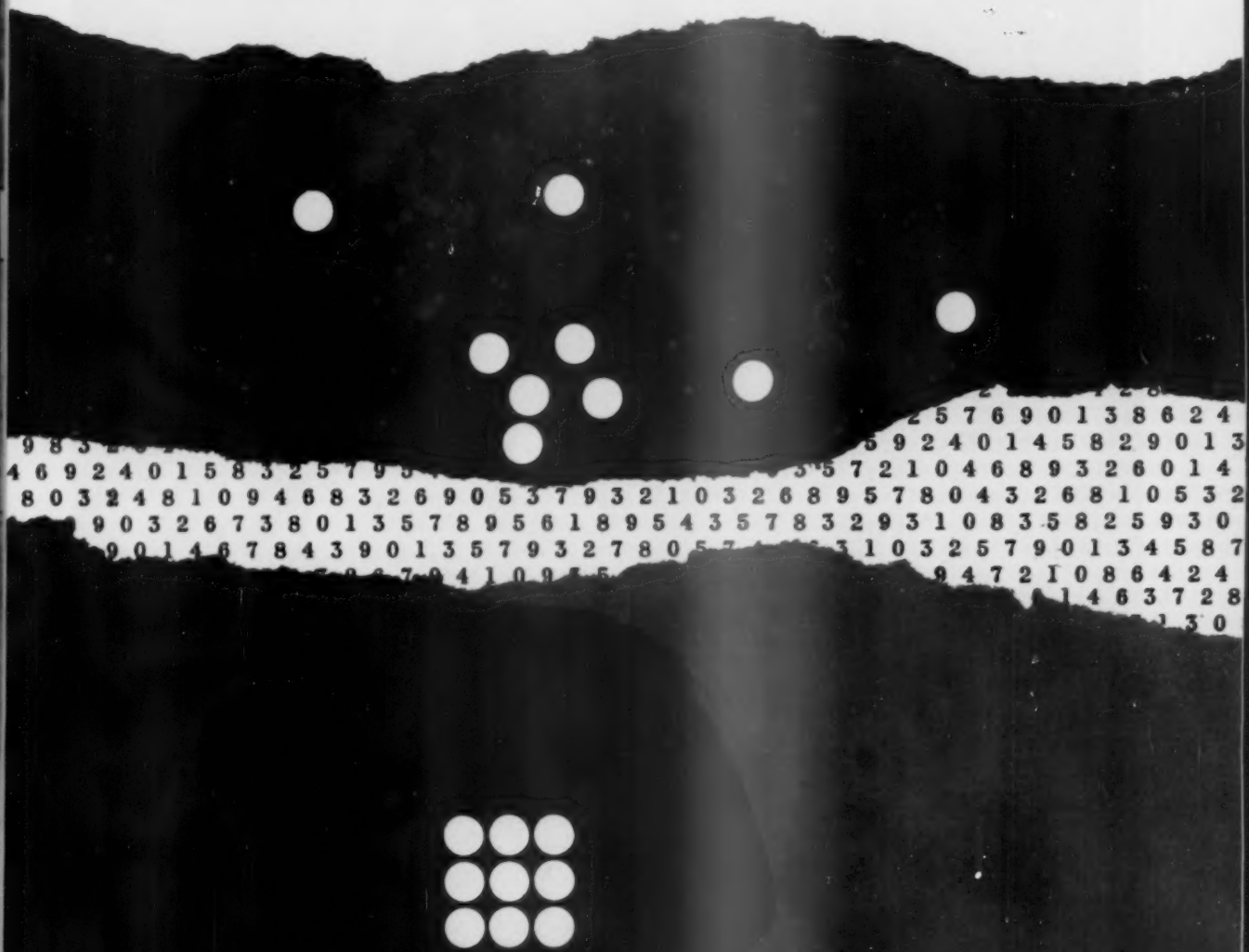

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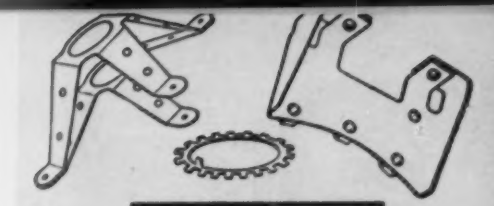

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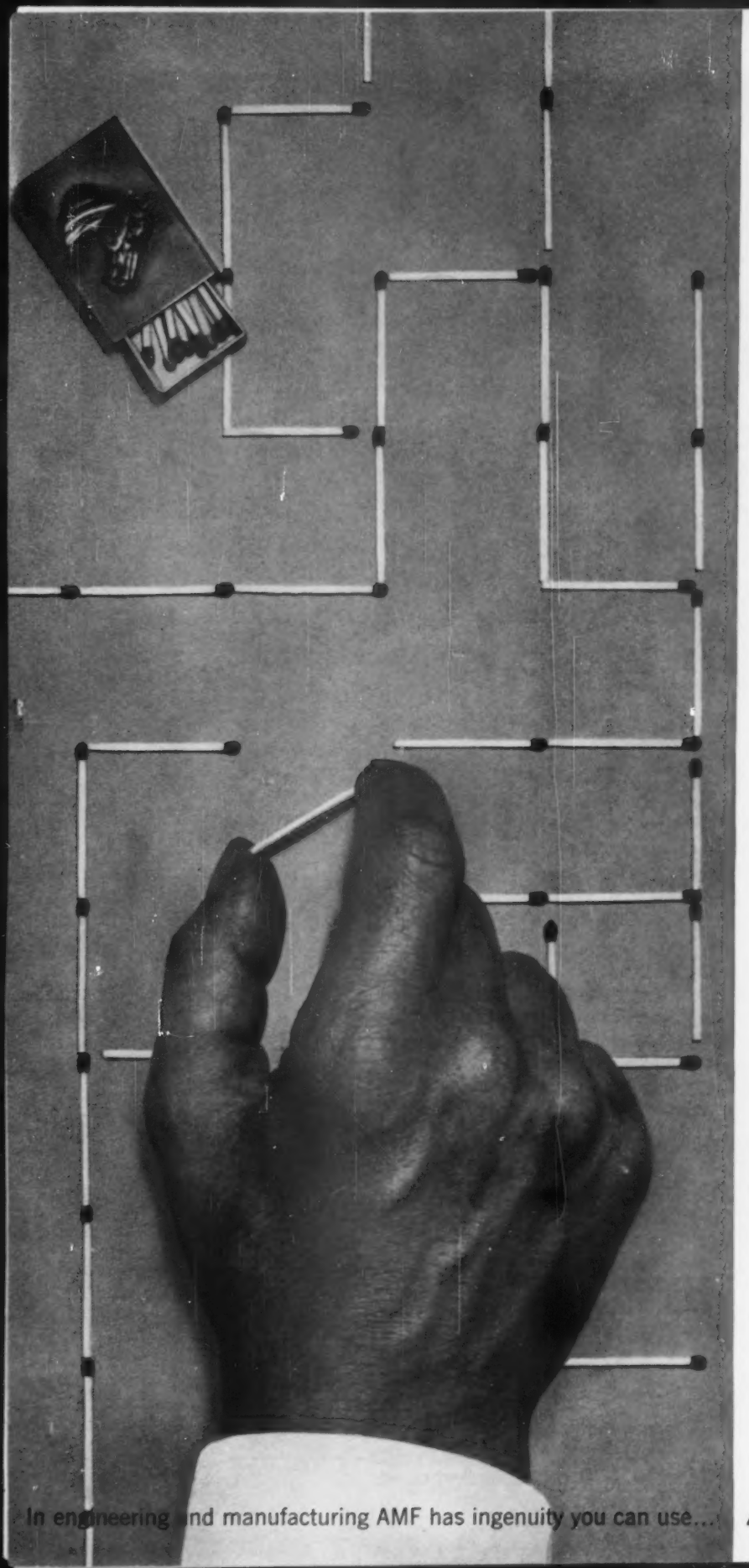

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COVER: Sikorsky HSS-2 anti-submarine warfare helicopters have logged 1,100 flight hours in test and demonstration flights at East Coast Navy air installations and at Sikorsky Division of United Aircraft's Stratford, Conn., plant, where photo was taken. The HSS-2 is powered by two General Electric T58 turbine engines each rated at 1,250 shp. maximum power. Each HSS-2 has a rescue hoist above the side door, and a UHF horn antenna protruding from the belly forward of the tail wheel. No. 4 helicopter also has a radio compass antenna underneath its tail, just below the letter "N" in Navy. White spots along upper portion of aft fuselage are inspection stickers.

PICTURE CREDITS

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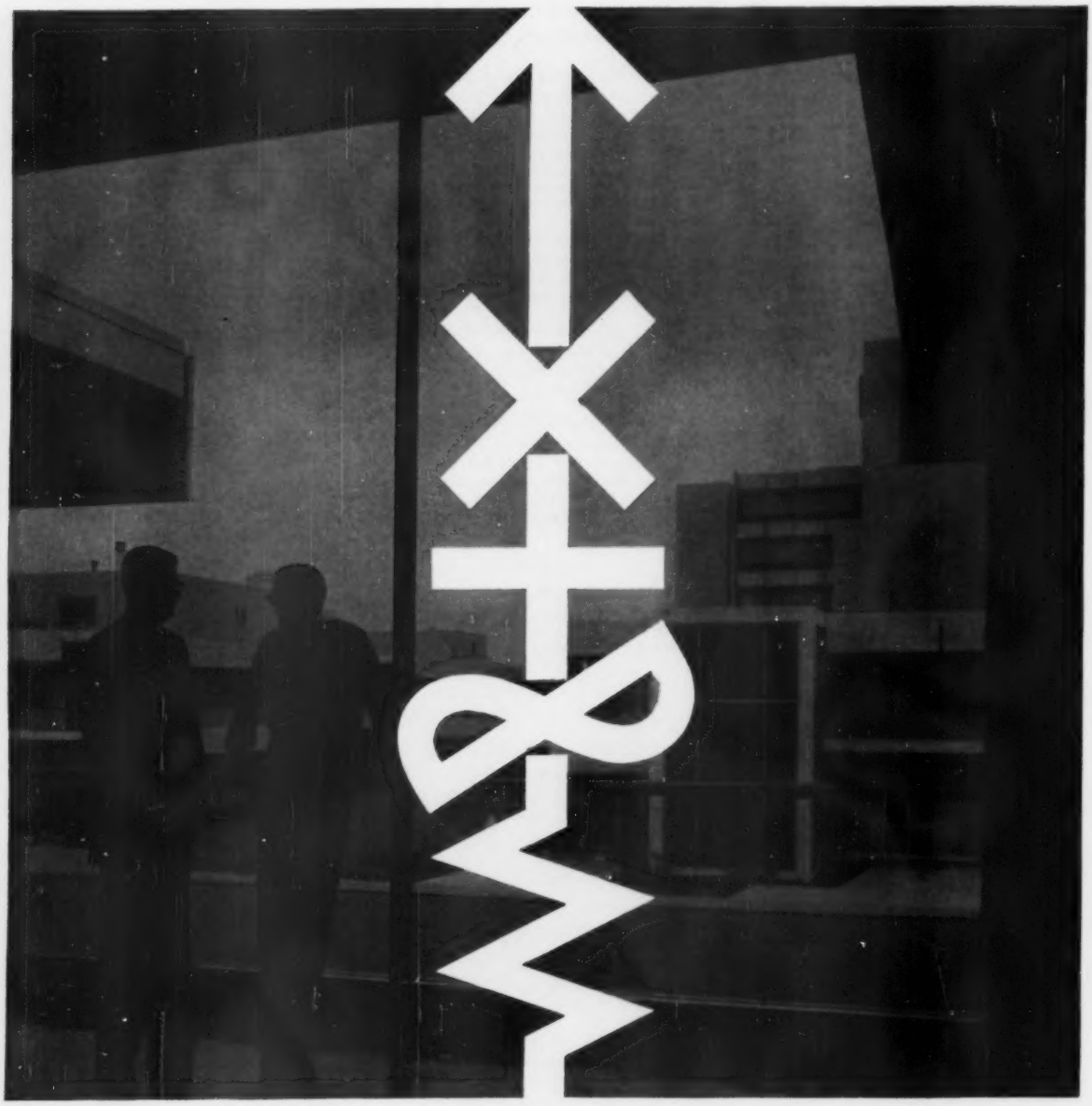

EDITORIAL

Gathering Storm Over Space

One of the major issues confronting the new President and the 87th Congress will be effective reorganization of the nation's space program. The Space Act of 1958 was admittedly a hurried answer to the challenge of the Soviet Sputniks. For that time, it did about the best possible job of getting a U.S. space research program under way quickly as a significant national effort. However, the years that have passed since then have seen some startling technical progress in space technology and some equally startling misunderstanding at top political levels of the future dividends to be harvested in both civil and military fields from the galloping advance of space technology.

Although the military services had been well along in developing the basic ingredients for effective space research long before the first Sputnik, the administrative panic that developed in the post-Sputnik era temporarily shut the door on this effort in favor of trying to sell space under the basically false premise that all space research must be under civilian auspices in order to promote a slogan of space for peaceful purposes. As a result, the space ball was handed off to the newly created National Aeronautics and Space Administration to carry on a civilian sweep toward the goal of "peaceful purposes."

It is now apparent that the first really effective use of space to preserve the peace lies in the development and use of operational satellite systems for communications, early warning and reconnaissance purposes, and that these are obviously functions of the military services rather than of NASA. It is also apparent that there are already applications of space technology for commercial purposes, such as communications, weather and television, that may not properly be the function of a government agency such as NASA but belong in the area of private enterprise. Indeed, many corporations are pressing hard for the opportunity to develop space systems.

Proper Role for NASA

Thus it is now apparent that the original concept of NASA as handling the total U.S. space effort was a rather shortsighted outlook, although understandably so in 1958, and that another basic look at U.S. space policy is urgently required. Both commercial and military organizations feel strongly that it is their function to operate various types of useful space systems, and that the role of NASA should be shrunk to that of basic and exploratory research with much the same function in relation to space technology that its predecessor, the National Advisory Committee for Aeronautics, performed in serving the needs of both military and civilian aviation so successfully for more than 40 years.

It is unfortunate that the NACA leadership, which had been so successful in working effectively with the military services and civil aviation in basic research and advanced development, was ignored at the top of the new agency. There is little doubt that ignorance of these working relationships with the military and industry has hampered the effectiveness of NASA as much as the problems of attempting to shift from a research organization to an operating agency.

There has been growing resentment in industry of NASA's trend toward technical bureaucracy. There is alarm in the military over NASA's attempt to duplicate or take over its already flourishing space research organizations and programs and NASA's lack of research programs aimed at supporting development of urgently required military space systems. Some of these misgivings are also shared by legislators in both Houses who have been keen followers of the space problem.

Military-NASA Battle Looms

There is already a rapidly widening gulf between NASA and the military services that see operational requirements in space, particularly the Air Force. There are indications on the horizon that the military services are becoming increasingly determined to air their problems with NASA before Congress in an effort to shake off what they regard as unnecessary technical shackles in pursuing their own vital development programs aimed at space weapon systems. It is also evident from some blips already appearing on the space scope that the military services may be pursuing a far broader and much more vigorous program than the tempo envisioned by the top level of NASA.

NASA might have avoided some of these pitfalls with a less abrasive approach to its military and industrial cohorts in the development of space technology. But for better or worse, the agency appears headed for a showdown with these former partners over who will be doing what in space programs of the future.

It was a little too much to expect that either the leisurely pre-Sputnik Vanguard approach or the hasty post-Sputnik decisions would produce an effective long-term pattern for effective management of space technology.

With the advent of a new President and a new Congress, plus the mounting pressures for development of operational space systems as the most promising warning of an enemy's aggressive intentions, it appears to be a propitious time to take a basic new look at all of the facets of the U.S. space program with a view to how effectively they are organized to meet our national goals in this area. A high priority exercise of this nature should have excellent prospects of producing a more realistic approach to these problems, stimulating a faster development pace and yielding larger dividends in the operational use of space for both military and civil purposes.

—Robert Hotz

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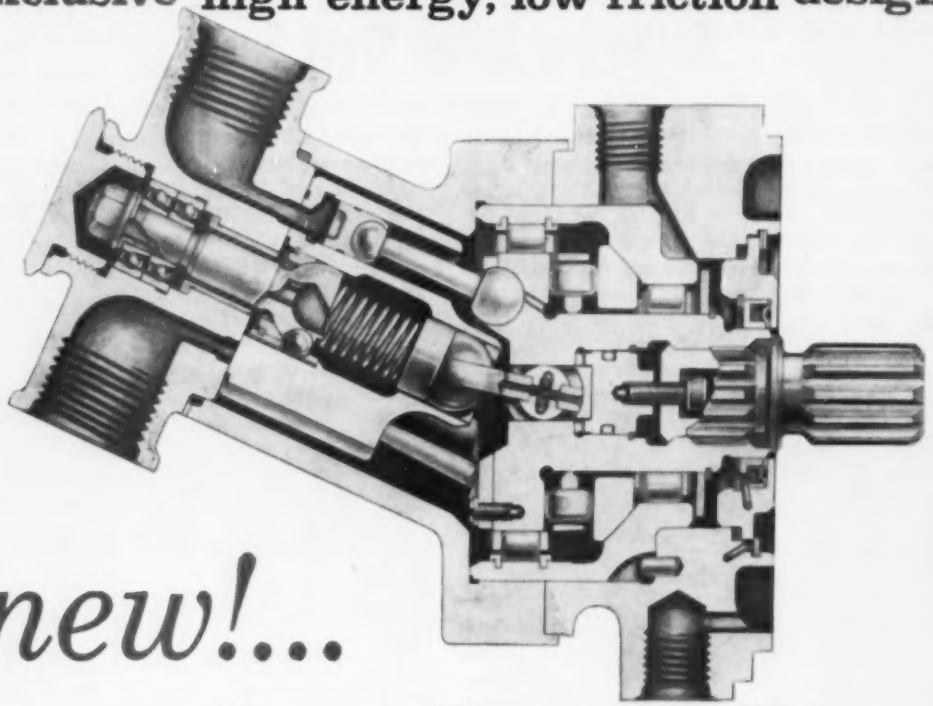

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Kenneth G. Farrar, a director, Douglas Aircraft Co., Inc., Santa Monica. Mr. Farrar continues as vice president-manufacturing.

Dr. M. Edmund Ellion, president, and **Dr. Melvin Gerstein,** vice president, Dynamic Science Corp., South Pasadena, Calif., a subsidiary of Marshall Industries.

Robert Young, president and general manager, Budd Electronics, Inc., Long Island City, N. Y., a subsidiary of The Budd Co., and **Jerome L. Strauss,** senior vice president.

F. Gorham Brigham, Jr., director, financial vice president and treasurer, Epsco, Inc., Cambridge, Mass. Also: **Ares G. Bogosian,** manager of Epsco's Advanced Concepts Engineering Organization.

Arthur H. Hausman, vice president and director of research, Ampex Corp., Redwood City, Calif., succeeding **Walter T. Selsted,** now vice president-engineering.

Richard B. Houghton, vice president-engineering for the California operations of Acoustica Associates, Inc.

Forbes Morse, a vice president, Waltham Precision Instrument Co., Waltham, Mass. Mr. Morse continues as president of the company's Electro-Mec Division.

Armand T. Audette, vice president-manufacturing, and **August C. Kircher,** vice president-design and development, Allied Control Co., Inc., New York, N. Y.

Howard A. Bond, vice president-systems and development, SIE Division of Dresser Electronics, Houston, Tex.

Oscar Ahlers, vice president and general manager, The Sheffield Corp., Dayton, Ohio, a subsidiary of The Bendix Corp., succeeding **C. Thorpe Thompson,** resigned. Also: **Roy Heldenbrand,** vice president-operations, succeeding **Louis Polk, Jr.,** resigned.

Lt. Col. Ralph P. Slater, director of information for Air Force Research Division of Air Research and Development Command, replacing **Col. Morgan Goodhart,** retiring. **Mel White,** former deputy director of information for Air Force Research Division, has become information officer for the Accident Prevention Program at U. S. Public Health Service.

Honors and Elections

Jacques Allez, president of the Aero Club of France, has been elected president of the Federation Aeronautique Internationale. Also: **Dr. W. Muri** of Switzerland elected first vice president, and **Jean Bleriot** of France re-elected treasurer.

T. K. Vickers, a senior design engineer at Hazeltine Technical Development Center, Inc., has been elected Midwest Councilor of the Air Traffic Control Assn.; he is the only ATC Councilor from industry.

Jimmie Mattern, pioneer aviator, has been elected president of the OX-5 Club.

Dr. W. Prichard Jones, British aeronautical scientist, has been appointed Visiting Jerome Clarke Hunsaker Professor of Aeronautics at the Massachusetts Institute of Technology.

INDUSTRY OBSERVER

► Design proposals for development of the Space Plane manned, winged vehicle have been submitted to Air Force by Lockheed, Republic, Boeing, Douglas and Convair. USAF hopes to get $20 million in Fiscal 1962 for studies of the vehicle, which would fly both within the atmosphere and in space (AW Oct. 31, p. 26).

► **Marquardt is studying the technique of scooping oxygen out of the atmosphere and liquefying it for storage as a propulsion oxidizer as part of its feasibility study of perturbation ramjets (AW Aug. 1, p. 78).**

► Storable liquid propellants are being urged for the 2,500 mi. A3 Polaris. Sales effort, which runs counter to strong Navy prejudice against liquid propellants on ships, is based on the technical argument that the range increase to 2,500 mi. cannot be made with solids within the current size limits of the missile. Powerplant groups at Aerojet-General, Bell, Reaction Motors and Rocketdyne are among those urging storable liquids for the A3.

► **Boeing Airplane Co. is conducting a study for National Aeronautics and Space Administration involving possible adaptation of the solid propellant Minuteman as a launch vehicle for space probes.**

► Dyna-Soar will use a turbine driven by hydrogen-oxygen propellant to produce electrical power. Hydrogen and oxygen will be stored cryogenically at temperatures just above the liquid state, and the stored hydrogen will be used to cool the vehicle's cockpit and avionics systems. Exhaust products from the turbine will be used for attitude control during flight out of the atmosphere.

► **Air Force plans to continue spending enough money to keep the Air Staff aware of VTOL technical developments, despite the decision to base the next generation Tactical Air Command fighter on a supersonic STOL design requirement. Some VTOL funds will be spent for company studies, the rest will be spent for internal USAF studies.**

► Magnetohydrodynamic cooling of re-entry vehicles and ICBM nose cones is being investigated by Bendix Systems Division. Technique would use flyweight magnetic material to give a nose cone a magnetic field which would interact with the surrounding plasma and produce cooling. Principle has been demonstrated in a shock tube.

► **Bell Aerosystems Co. has been invited to join the group of German aircraft companies—Messerschmitt, Heinkel and Bolkow—which is developing a multi-engine supersonic VTOL fighter for the West German air force. Representatives of the German firms were briefed recently on Bell's progress with the D-188A, a Mach 2 V/STOL fighter design now in the mockup stage.**

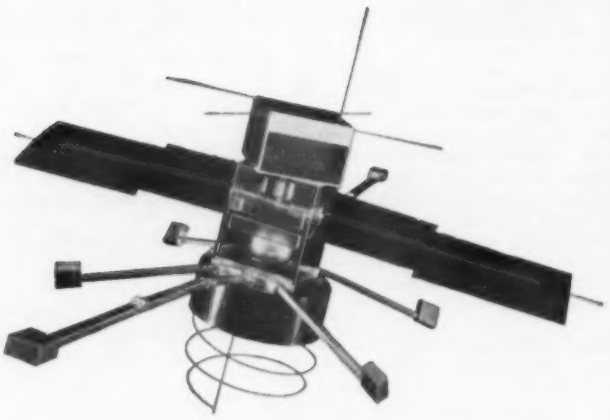
► Navy is rushing tests of gadolinium selenide, a new thermo-electric material claimed to have a figure of merit 50 times better than any previously known material for power generation. Measurements reported by Research Chemicals Division of Nuclear Corp. of America indicate a figure of merit of 0.045 at 800C.

► **Douglas may join Piaggio to develop and market a light executive aircraft. Italian company would manufacture the airplane to keep costs down, and Douglas would run the sales effort in the U. S and Europe.**

► Lockheed QF-104 drone is scheduled to make its first unmanned flight late this month at Eglin AFB, Fla. QF-104 is flown through the drone system but with a pilot aboard in current tests at Palmdale, Calif.

► **Three NASA U2s shipped to the U. S. from their base at the U. S. Naval Air Station, Atsugi, Japan are now in hangar storage at Edwards AFB, Calif.**

► Fleet of disarmed Soviet Il-28 bombers is used by Aeroflot to gather weather data. The aircraft are based at 11 of the largest Soviet commercial air centers, including Moscow, Tbilisi, Tashkent, Kiev, Irkutsk and Khabarovsk.



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NEW ACHIEVEMENTS IN SPACE have been made by Bendix "Reaction Jets" which helped put capsules in orbit, steer them, and recover them. Now we offer the "Free Reaction Sphere" which is a new automatic pilot concept for interplanetary flight. Bendix has also developed highly reliable radio receivers and transmitters, using our "Selective-Redundancy" principle, which open a new era in space communications. These are programs offering new careers for better engineers and scientists.

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Washington Roundup

'Revolutionary' Nuclear Weapon

A "revolutionary" third-generation nuclear weapon that will make massive-deterrent atomic and hydrogen bombs and warheads obsolete has been designed but is not being developed because of the voluntary U.S. ban on weapons testing, according to former Atomic Energy Commissioner Thomas E. Murray.

This weapon is "primarily anti-personnel in destination and effect," lending itself to "a new type of nuclear strategy that would be more narrowly military in character," Murray said.

It is the first departure of nuclear weapons technology from the straight line toward massive megaton weapons, and is "as radically different from the H-bomb as the H-bomb was from the Hiroshima-type A-bomb."

Since this weapon would not create suicidal hazards for the country that employs it, the first to possess it will possess a moral argument that is not possible in the case of mass-destruction weapons. World sanction against the use of the older weapons would make the third-generation weapon a new symbol of strength and the massive weapons a symbol of weakness, Murray said.

In the two-year hiatus since the U.S. ended weapons tests, the Soviet Union probably has actively developed nuclear technology along the lines of the new weapon. "I must assume that they have done some preliminary tests of the new 'fantastic' weapon," Murray said. "Such tests could easily have been carried on without detection."

Because of this, "our whole stationary nuclear establishment may well be no more than a Maginot line, behind which we sit in illusory security," Murray said.

Existence of "conceptual designs" of this new weapon that would have been carried to the testing stage by now except for the moratorium was revealed in Murray's second open letter to presidential candidates John F. Kennedy and Richard M. Nixon. Murray said neither had come to grips with the basic issue in the matter of nuclear tests nor "given public evidence of a full understanding of the essential danger created by our current test moratorium and by the arms control policies that surround it."

Murray urged both men to make "a more exact consideration of technological realities" in their relations to these problems.

Space Surveillance

Acceleration of the Rover nuclear rocket program (see p. 32) is being attributed partly to pressure from Sen. Clinton Anderson, who has been critical of its progress for some time, and partly to the watchful interest of the House Science and Astronautics Committee. NASA's official reason is Atomic Energy Commission's success with the ground test versions of the reactor. Much of the reactor work is done at AEC's Los Alamos, N. M., laboratory in Anderson's home state.

Senate's Committee on Aeronautical and Space Sciences is more interested in possible duplication between NASA and the Air Force in booster development, particularly large solid rockets.

No formal investigations are expected before Jan. 1 unless a notable Russian success brings the space congressmen back to town.

Sen. Stuart Symington has no desire to become Secretary of Defense if the Democrats win the White House. The Missouri senator is a former Air Force secretary and a specialist in defense legislative affairs.

Symington's support of Sen. John F. Kennedy for President after Symington himself lost a bid for his party's nomination led many to believe that he would get the defense post. But Symington says he prefers to remain in the Senate, where he can help push Democratic programs.

Phony Soviet Labels

Russia has blocked another attempt to penetrate the mystery surrounding the latest Soviet air force aircraft.

National Aeronautic Assn. proposed that publication of pictures of record-breaking aircraft in the Federation Aeronautique Internationale bulletin be required. This was an attempt to counter Russia's use of obscure designations when it claimed new aircraft records.

But Russia's FAI member, the Central Aero Club, said many record-breaking planes do not belong to the club, and the Soviet government would not permit release of the pictures. FAI adopted a Soviet amendment making publication of the photos optional.

Federation Aeronautique Internationale will hold its 1961 general conference at Brasilia, the new capital of Brazil, next October.

—Washington Staff

Orbit Launch, Rendezvous Studies Sought

Marshall Center asks proposals for six-month projects; program involves manned space platform.

By Edward H. Kolcum

Washington—Feasibility of launching a manned spacecraft to the moon from an earth orbit and of automatic orbital rendezvous systems will be studied in related National Aeronautics and Space Administration contracts to be awarded within the next few weeks.

Industry proposals for the separate six-month studies are being solicited by Marshall Space Flight Center. The cost-plus-fixed-fee study contracts are expected to amount to several hundred thousand dollars. Deadline for bids on the study of orbital launch operations is Nov. 7, and proposals for rendezvous studies are due Nov. 21.

Purpose of the orbital launch study is to establish design criteria, manpower needs, cost, scheduling and conceptual data for a manned space station from which manned lunar landing and cislunar spacecraft can be boosted into an escape trajectory.

Studies are to be based on the use of Atlas Agena B, Centaur and Saturn C-2 for launching systems into earth orbit.

Rendezvous project calls for a detailed definition of an automatic method for demonstrating rendezvous of a chasing payload with an orbiting target. Atlas Agena B is the vehicle to be used for earth launch, but the system must have potential for growth to be compatible with the Saturn vehicle.

NASA hopes the orbital launch, or indirect trajectory, feasibility study will verify preliminary theories developed at Marshall which conclude that planetary flights are possible for orbit much sooner than they will be when launched directly from earth to the planets. The direct earth launch approach has been used in Pioneer satellites, but it is attractive only for small payloads.

Orbital Launch Requirements

The advanced orbital launch operation foreseen by NASA could include a requirement not only for a space station from which spacecraft would be launched, but also for a satellite complex of orbiting weather, communications, reconnaissance and defense systems.

In the work specifications for the launch-from-orbit study, NASA is asking for detailed analysis in these specific areas:

- **Propulsion,** defining problem areas and recommendations for solution using an all-chemical propulsion system and either an all-nuclear or a chemical-nuclear system. Requirement also calls for design criteria and promising design approaches for these engines.
- **Vehicle design concepts** for a vehicle launched from orbit with a lunar payload, and equipment arrangement of the orbiting launch platform for a lunar mission using nuclear, chemical and nuclear-chemical engines.
- **Cost and time estimates** to design, build and test a great range of equipment, including the orbital launch facility, spacecraft, equipment to sustain a permanent complex and orbital launch vehicles of the three types being considered.
- **Numbers of earth-launched** payloads and firing rate to put the equipment into orbit, assuming that robot mechanisms can be used to maneuver payloads.
- **Time to assemble,** check out and launch the orbital system into an escape trajectory using the three propulsion systems.
- **Schedules** for the entire program and launch rate to meet an integrated schedule.
- **Manpower requirements** for orbital assembly of the launch facility; for assembly, checkout and launch of spacecraft with lunar payloads; for assembly and checkout of equipment to prepare the payload for launch; and for sustained operations of the launch facility and associated satellites in the complex. Biomedical areas largely unknown or marginal in existing knowledge are to be identified.

This study assumes that adequate earth launch facilities will be available to sustain the program, and that nuclear propulsion will be available by 1967 for earth and space-launched payloads. Power range of nuclear systems will be 1,000-5,000 mw.

Study Emphasis

Because primary emphasis will be placed on problems of launching space vehicles from orbit, the study does not include a requirement for detailed analysis or costs of transportation between earth and the orbital station. Study does require consideration of emergency escape, crew rotation, fuel storage and transfer, cargo and personnel transfer, communications, countdown and checkout procedures, and rescue after launch from orbit.

The over-all rendezvous problem will be considered in the second study, but the launch operations study calls for evaluation of retrieving and docking payloads after they have been placed within 500 ft. of the working area.

Two-part goal of the rendezvous study is preliminary design of a rendezvous system and selection of an automatic method for joining a maneuverable chaser with a target in a stable orbit.

Broad goals of the study are to:

- **Establish payload design** in enough detail so that it can be used as a basis for writing hardware specifications.
- **Develop three-dimensional** trajectory equations to describe motions of chaser and target from orbital injection to completion of rendezvous. Mathematical equations will include an error analysis.
- **Outline a rendezvous** research and development program, including number and type of vehicles required, launch rate, payload funding and earliest possible time in which flight tests can be made.

Primary mission of the first test flight will be demonstration of the rendezvous techniques using an automated system

Satellite Launch Ship

Washington—Navy will ask funds for a satellite launching ship in its Fiscal 1962 budget request. Several companies have proposed such ships, and Navy also has made its own studies.

Feasibility of launching relatively large rockets from shipboard was demonstrated years ago with the firing of liquid propellant Viking research vehicles. For satellite work, Navy probably would depend on solid propellant boosters, possibly launched from a tube in the deck of a converted ship in much the same way that Polaris missiles have been launched in tests from the USS Observation Island.

In a speech prepared for a Navy League New York Council dinner, Vice Admiral W. F. Raborn, Jr., head of the Polaris Special Projects Office, said that "much outer space activity will call for seaborne launching, tracking and recovery on the basis of geography alone." His original statement that Navy "has already authorized an astronautic ship, to be commissioned next year to meet such needs" later was changed to say that Navy "has plans for" such a ship, and to delete reference to a commissioning date.

for both coarse and precision (docking) maneuvers. Mechanical design of target and chaser requires that they be boosted out of orbit once they are connected to demonstrate the value of rendezvous. With Atlas Agena B booster, the payloads will be lifted into a near-earth synchronous orbit with 94-min. period.

Study assumes that variable thrust engines will be available, and that the chaser payload will carry active rendezvous propulsion.

Study of the rendezvous maneuver will center around these three phases of chaser payload flight:

- **Main stage cutoff,** including parameters for deviation errors of ascent guidance and fuel economy. Statement is sought of the optimum altitude, range to target, velocity and direction of velocity in a direct ascent trajectory. Cutoff parameters for best fuel economy are to be calculated in an indirect rendezvous where the orbit of the chaser must be phased with target orbit.
- **Course maneuver,** requiring three-dimensional equations describing chaser approach to target, and equipment needed to transmit homing data for course correction. Precise attitude control system design is called for, with specification of nozzle size, number, location and burning characteristics. Error analysis will be made of coarse maneuver equations and hardware and accuracy and fuel cost will be determined.
- **Docking maneuver,** in which mechanical design of the contact arrangement is specified and evaluated, hardware attitude guidance appraised and contact conditions—attitude and relative velocity—established.

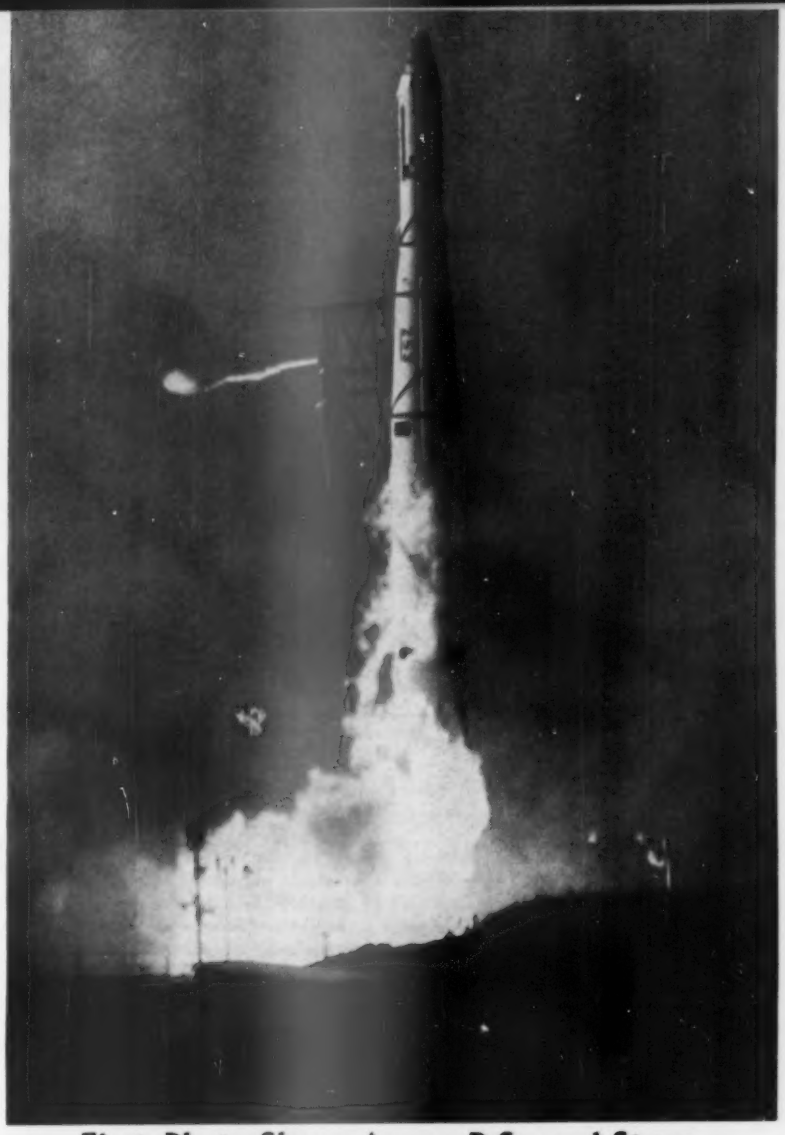
Major problem areas in chaser maneuvering during the rendezvous are considered to be propulsion burning time, flame effects on the target, and nozzle materials. NASA has specified that nozzle arrangements must be such that electromagnetic equipment can operate if sensing is to be accomplished during thrust.

These two studies are among 14 future projects being funded by Marshall (AW Oct. 3, p. 32) for the current fiscal year under a $3.1 million authorization.

Navy Plans to Begin Polaris A2 Testing

Washington—Navy and Lockheed will begin testing the 1,500 naut. mi. A2 version of the Polaris missile from Cape Canaveral, Fla., this month.

Development flight testing of the 1,200 naut. mi. A1, which has included more than 50 launchings, is almost complete. It has included 12 submerged launchings from the fleet ballistic missile submarines George Washington and Patrick Henry.



First Photo Shows Agena B Second Stage

Discoverer XVI topped by Agena B—first time this second stage has been used on any boost vehicle—was successfully launched at Vandenberg AFB Oct. 26 but second stage failed to separate from Thor booster, and orbit was not achieved (AW Oct. 31, p 34). Agena B contained a special experiment consisting of external lights for optical tracking by camera stations of Smithsonian Institute's Astrophysics Observatory. Agena B thrust is 15,500 lb., length is 25 ft., compared with basic Agena vehicle length of 19.2 ft. Weight with full fuel load is 15,500 lb. as against previous Agena full fuel weight of 8,500 lb.

The Aerojet-General first stage for the A2 is 30 in. longer and several hundred pounds lighter than the A1 first stage, and it provides half to two-thirds of A2's added performance over A1. Hercules Powder's second stage also is lighter and has greater thrust than the Aerojet second stage used in the 1,200 mi. missile.

In the political sphere, the British government announced an agreement with the U. S. to permit basing of Polaris subs in Scotland, confirming AVIATION WEEK's prediction (AW Oct. 31, p. 25), and immediately ran into criticism over the question of how much control Great Britain will retain over the operation of the submarines.

Britain and the U. S. recently revised their agreement on the basing of USAF aircraft there to give Britain a stronger voice in controlling the types of flights made. This was a direct outgrowth of the U-2 and RB-47 incidents.

Critics charged that basing of Polaris subs in United Kingdom territory could lead to involvement with other powers. Prime Minister Harold Macmillan said there would be the fullest possible consultation with the U. S. on use of the subs, but the U. S. State Department said the Navy has no commitment to Britain to confer in advance before firing missiles in international waters.

Services Apply R&D Cost Restrictions

New York—First tangible indication of actual dollar costs of a revised procurement policy on company-initiated research and development programs is provided by Grumman Aircraft Engineering Corp.'s third quarter financial statement.

The policy, first enunciated to contractors by the Air Force (AW Feb. 22, p. 29), provides that costs of such programs will no longer be picked up fully by the services as part of overhead on military production contracts.

Grumman President E. Clinton Towl told the New York Society of Security Analysts that the company had been required by the Navy to absorb 50% of such costs—retroactive to Jan. 1, 1960—for a total estimated reduction in profits for the year of $814,000.

The revelation sent a mild shock wave through financial circles since many analysts do not specialize in aerospace companies and were not familiar with the revised regulation. Thus there was a tendency to magnify the problem and confuse company-initiated R&D with all R&D. Government-initiated programs still are 100% supported.

Towl did not discuss the problem in detail, but the 50% figure apparently referred to an arbitrary average that Grumman and the Navy had agreed to for the year.

Tri-Service Committee

Administration of the regulation has been assigned by the Defense Department to the three services through a tri-service committee. The committee maintains a list of 40-50 contractors and, through one of the individual services, negotiates an agreement with each company on how much company-initiated R&D will be supported. Agreements are short term, usually for a year.

Affected companies are showing more concern over how the regulation is being interpreted rather than over the principles involved. As Towl told the analysts: "Many companies were doing research on anything they could think of and Uncle Sam just got tired of paying the bill."

One debated point has been an interpretation by the services that the regulation requires that general overhead be allocated pro rata to research and development before the sharing level is negotiated. The result has been that what companies feel are legitimately allowable overhead costs—executive salaries, administrative expenses, etc.—are thus arbitrarily declared non-allowable as company-initiated R&D.

This area was referred to here last week by Dudley E. Browne, vice president-finance for Lockheed Aircraft Corp., during a visit by Lockheed officials to discuss Lockheed's third quarter results.

Asked about the Grumman statement, Browne said that Lockheed had not been submitting for reimbursement a flat 10% of its over-all R&D costs. Though Lockheed had not completed negotiations, Browne felt that this would put Lockheed in the ballpark as far as the actual amounts required by the services.

Industry Squeeze

Browne related this problem to the general squeeze on aerospace company profits. If the contractor is required to assume a greater share of the risk—more company-financed R&D and more investment in company-owned facilities, for example—and no compensation is made in profits, he said, "we're going to have trouble down the road."

Grumman's $814,000 R&D write-off was on a nine months net profit of $5,589,638 or $2.54 a share on sales of $240 million after provision for the added R&D charges. This compares with sales of $199 million and profits of $2,670,644 or $1.21 a share for the same period last year when development costs of the commercial Gulfstream turboprop executive airplane were being written off. Full year sales of $320 million and earnings of $7.3 million or $3.32 a share were forecast. Grumman also is evaluating at Navy request the purchase of some or all of its Navy-owned facilities. Grumman owns about 30% of the land and buildings at its Bethpage, N. Y., complex but none of its new Peconic River, N. Y., facility.

Lockheed faced this same situation a year ago in respect to its Marietta, Ga., plant, but decided against purchase. One problem has been that the plant

NATO Receives Variable Sweep Data

Paris—U. S. data on variable sweep concepts have been turned over to North Atlantic Treaty Organization nations taking part in NATO's VTOL fighter competition.

One of the competitors, Fokker of Holland, is planning to submit a variable sweep, all-weather VTOL design. Fokker reportedly will design its project around work currently being done in this field by Republic Aviation, one of the Dutch company's major stockholders. Alexander Kartveli, Republic vice president, research and development, will meet with Fokker officials early next month to reach firm agreement on the project.

National Aeronautics and Space Administration officials demonstrated in a recent Paris meeting that the use of variable sweep wings would yield performance far in excess of NATO's current general operating requirements for its VTOL fighter. Aircraft with variable sweep wings could fly supersonically at all altitudes, while the GOR calls only for subsonic speed at low level (AW Sept. 26, p. 23).

NATO officials close to the VTOL program, however, discouraged reports that the program's present general operating requirements might be revised as a result of the introduction of variable geometry data. The price of such an aircraft, as well as its operating costs, might offset superior performance.

In any case, these officials seemed fairly certain that NATO's currently-accepted GOR for the VTOL competition would remain unchanged. NATO officials say it would be impossible to scrap all the work achieved to date and start from scratch.

Instead, what might happen is that the present general operating requirements would be considered as minimum performance requirements. In this way, any competitor who wanted to take the risk could submit a project promising performance above this minimum.

Other observers, however, wondered if the program could prevent itself from being changed—as long as one or more competitors submitted higher performing projects. Moreover, the NATO VTOL program is aiming for an aircraft to be operational within four to six years. Present NATO GOR for its VTOL fighter might be painfully out-of-date by then.

This whole question very likely will come to a head at a scheduled NATO meeting on the VTOL program in January. At this meeting, as currently planned, competitors will be asked formally to approve the existing general requirements of the VTOL program. Competitors who want to see the program reoriented toward higher performance standards will have to make their views known at this point.

West German aircraft group, including Messerschmitt, Heinkel and Bolkow, is developing a supersonic VTOL fighter for the West German air force (see p. 23). This group has invited Bell Aerosystems Co. to contribute its design experience from the Bell D-188A project, and the German VTOL fighter design undoubtedly will be an entrant in the NATO competition.

First Photo of Dassault Mirage III Production Line

First photo of Mirage III production line at Dassault's Merignac assembly plant near Bordeaux, France shows first production model of Mirage III-C, which flew for the first time last month. By next spring production rate of the supersonic delta wing fighter is scheduled at nine aircraft per month. French air force has placed an initial order for 200 aircraft, which has also been sold to the Israeli air force (AW July 11, p. 111).

must be sold at original cost by the military unless it is declared surplus. In the latter case, the Air Force might have been forced to sell to a higher bidder than Lockheed, with attendant disruption of the C-130 Hercules program and others, and as a result the plan has been shelved.

Lockheed reported a third quarter profit of $5,485,000 on sales of $305,221,000. The profit helped reduce its $55 million mid-year net loss—brought about by extensive write-offs in its Electra and JetStar programs—to $49,924,000 for the first nine months of 1960. Chairman Robert E. Gross said that the company should do at least as well in the last quarter and that the net loss thus would fall below $45 million for the year.

Although Lockheed included in the write-off $25 million in anticipated Electra modification costs, only about 15% of these have been incurred to date. Actual costs so far have differed slightly from estimates, but not greatly, Gross said. Other financial reports:

• **Boeing Airplane Co.** reported nine-month net income of $16,167,061, or $2.03 a share, almost twice that of the same period last year, on sales of $1,202,225,286. Contribution of the 707 jet transport program to profits was primarily responsible for the improvement. Boeing voted to increase its quarterly cash dividend from 25 to 40 cents in lieu of stock dividends.

• **Martin Co.** nine-month sales rose 23% to $466,295,137 and earnings 28%, to $12,190,994 or $3.95 a share compared with the same period last year.

• **Northrop Corp.** reported earnings of $7,740,219 or $4.22 a share for its fiscal year which ended July 31. This was 5.6% higher than the previous year's $7,325,404. Sales totaled $233,679,427, a decline of 12% from the previous year total of $263,034,650. Northrop President Thomas V. Jones reported that the company turned the sales corner in the third quarter and that the company's backlog at year end stood at $309 million compared to $204 million the year before.

• **Thiokol Chemical Corp.** reported that non-fee bearing contract overrun costs on Minuteman continued to reduce company profits in the third quarter. Earnings for the nine months of $2,663,006 on sales of $124,429,898 were 34% under the same period last year.

Johnson Rebuts Nixon Space Claim

Washington—Congress set the pace for America's achievements in space, "pulling along a reluctant Administration," Sen. Lyndon B. Johnson, Senate Space Committee chairman and Democratic vice presidential candidate, charged last week.

In a statement issued to counter Vice President Richard M. Nixon's earlier claim that the Eisenhower Administration has led the U.S. to first place in space exploration (AW Oct. 31, p. 30), Sen. Johnson said: "Despite efforts to prove the contrary, the record of American exploration of outer space is clearly one of the congressional desire for action, pulling along a reluctant Administration."

Sen. Johnson said Nixon, the Republican presidential candidate, now claims that the Republican Administration "long ago recognized we were in a strategic space race with Russia," yet, Johnson said, Administration spokesmen following the launching of Sputnik belittled the Russian achievement.

"Vice President Nixon's current acknowledgment that we have been in a space race with Russia is a belated recognition of an obvious fact," he said. "The sad truth is that U.S. progress in space has been continually hampered by the Republican Administration's blind refusal to recognize that we have been engaged in a space and missile race with the Soviet Union and to act accordingly."

Sen. Johnson also said Congress has had to provide more funds than the Administration requested in order to expand and accelerate ballistic missile programs such as Atlas, Titan, Minuteman and Polaris, and satellite programs such as Discoverer, Samos and Midas.

"Administration failure to push the missile programs and use the funds provided by Congress fully and promptly," he said, "has delayed many of these important programs and is a direct cause of a prospective Soviet three to one superiority over the U.S. in intercontinental ballistic missiles during the next several years. The situation has been made even worse by recently revealed ineptitude and mismanagement of our missile base construction program, which is currently at least six months behind schedule," he charged.

"Despite the scientific and technological successes achieved by U.S. satellites and space probes," Johnson said, "the U.S. position of world leadership and prestige has been severely damaged by Russia's spectaculars in outer space—first earth satellite, first to orbit the sun, first to orbit the moon, first to hit the moon, first to photograph its hidden side and first to bring live animals back from orbiting the earth. The delays in our own Project Mercury now make it appear more likely than ever that the Russians will also be first to achieve manned space flight."

Air Force Asking $580 Million For Fiscal 1962 B-70 Program

Washington—Air Force has asked for $580 million to accelerate development of the North American B-70 supersonic bomber in Fiscal 1962, more than double the $265 million—including $55 million released last week—Defense Department has allotted the program for the current fiscal year.

With Fiscal 1962 budget submissions varying from 5% below this year to 10% above, the figure requested could be cut as low as $350 million, but a larger budget seems a good prospect for Defense approval in light of last week's action.

B-70 funding now is oriented toward weapon system prototypes rather than airframe test vehicles. There will be one airframe test vehicle, and a static test airframe.

In addition, two of a proposed series of weapon system prototype test vehicles will be built, including essential subsystems.

First flight for the airframe test vehicle is scheduled for late 1962, and the weapon system prototype is to fly a year later.

Department of Defense has been subject to mounting pressure from Democrats in Congress to augment the program, which was curtailed last year for economy reasons. Congress voted the additional funds, but Defense held them back until last August (AW Aug. 15, p. 26).

Originally, the Air Force had requested $463.9 million for Fiscal 1961 work on the B-70. This was pared to $75 million. Entire B-70 program was planned to cost $5.5 billion, with the aircraft to be operational in quantity in 1965.

In addition to the $75 million, Air Force managed to scrape together another $35 million to continue bomb navigation system development work by International Business Machines Corp.

After the summit meeting collapsed in May, Congress voted $290 million above the President's $75 million request for the B-70. Money has been released piecemeal for this program, along with other extra funds voted by Congress. First increase for the B-70 was $100 million in August. With the $55 million released last week, the total available now stands at $265 million.

Another $130 million remains in additional funds that could be applied to the B-70, including $100 million for interceptors which Defense is authorized to shift to the B-70 if it chooses. Indications are that the B-70 program will not be allotted any more money this fiscal year.

Work on many key component systems, dropped last year with the cutback, can now be reinstated. Development of the defensive system of radar acquisition and air-to-air rockets will be resumed by Westinghouse Electric Corp., and traffic control system, which must be highly automated for a 2,000 mph. aircraft, will be developed by Motorola, Inc.

Air Force wants to build 12 operational prototypes to test the feasibility of the entire B-70 system. Various concepts will be tried, including missions as a conventional bomber operating from 70,000 to 80,000 ft., as the platform for an air-launched ballistic missile, or as a supersonic troop transport.

Douglas Will Study Spacecraft Propulsion

Santa Monica—Douglas Aircraft Co. has acquired a subsidiary named Astropower, Inc., to perform research in electrical, nuclear and high-energy chemical propulsion systems for spacecraft.

Astropower is an outgrowth of Aero-Space Technology, Inc., a corporation formed by propulsion researchers Y. C. Lee and Dr. George Moe and engineering administrator E. W. Smith. Lee headed the original company and will remain as president of the Douglas subsidiary. Dr. Moe is vice president and technical director and Smith is vice president-administration.

Operations of the new firm will be governed by a board of seven directors representing Douglas and the three founders of the original corporation. By virtue of its stock holdings, Douglas owns a controlling interest in Astropower.

Research and development of electrical propulsion techniques by Astropower will cover ion engines, heavy charged particle engines and thermal arc plasma engines. Projects involving solid-state devices and energy conversion equipment will use advanced thermionic and thermoelectric techniques.

Lee said he expects that by the end of the first year of operation Astropower will have a staff of about 100 scientists, engineers and technicians. Plans for facilities and equipment are being drawn up and will be announced later, he said. Lee is a consultant to the propulsion panel of the Scientific Advisory Board of the Air Force and is a member of the Research Advisory Committee on Electrical Energy Systems in National Aeronautics and Space Administration. In 1947 he was selected to direct the design and construction of a supersonic wind tunnel for the University of Southern California. Lee was manager of the Aerojet-General Advanced Research and Products Division at the time of his recent resignation. He is noted for his studies in the fields of advanced propulsion, high-temperature materials, aerodynamics and combustion dynamics.

Dr. Moe was technical director of Aerojet's Astronautics Laboratory.

Kennedy on B-70 Budget

Los Angeles—Sen. John F. Kennedy said last week that the Administration's decision to release $155 million for B-70 development was made "to increase Republican votes."

Sen. Kennedy pointed out that more than $155 million was made available a year and a half ago by Congress in the Defense appropriations for Fiscal 1960. Of the $345 million voted for the B-70 for Fiscal 1960, the Administration impounded $195 million and allowed the Air Force to spend only $150 million, he said.

The Democratic presidential candidate observed that "$1.1 billion voted for defense purposes by the Democratic Congress was impounded in July by the Republican Administration and nearly $400 million remains impounded. . . ."

Recycled Water Drunk During Six-Day Test

Washington—Navy medical service officer has completed a six-day experiment to demonstrate a urine recovery-purification system which could be used in a manned spacecraft to save weight.

Capt. Roland A. Bosee, director of the Navy's Air Crew Equipment Laboratory in Philadelphia, for six days drank no other liquids but his own urine purified by a General Electric high temperature oxidation device. GE's Missile and Space Vehicle Department said test results were processed last week, and Bosee suffered no adverse effects from drinking about two quarts of purified urine each day over the six-day period.

Bosee plans to combine the metabolic waste purifier with an oxygen recycling apparatus to determine the effects in an extended space mission. Systems have potential application for nuclear aircraft, as well as for spacecraft, to save the weight of water supplies on long flights.

EXPLORER VIII satellite package is subjected to vibration test at left. Instrument column is assembled at right.

Space Technology

Explorer VIII Mapping the Ionosphere

Washington—Successful launch and operation of the Explorer VIII satellite has given scientists a first chance to sample the upper ionosphere directly, which could result in new design theory for long-range communications systems.

The 90-lb. battery-powered package was launched by a Juno II vehicle at 12:24 a. m. EST Nov. 3 from Cape Canaveral, Fla. Containing eight experiments, the satellite consists of two truncated cones fastened to a cylindrical center section. It is expected to transmit data for about three months.

The apogee of 1,423 mi. and perigee of 258 mi. will take the instruments through the upper layers of the ionosphere, which merges with the exosphere at an altitude of about 500 mi. Initial period was 112.75 min.

Although the primary objective of Explorer VIII is direct ionospheric sampling, the satellite also has been designed to measure static electricity accumulation on its surface, study micrometeorites, and establish the altitude of the base of the exosphere. Satellite structure is aluminum, instead of the glass fiber used for Explorer VII, so that the static charge can be measured.

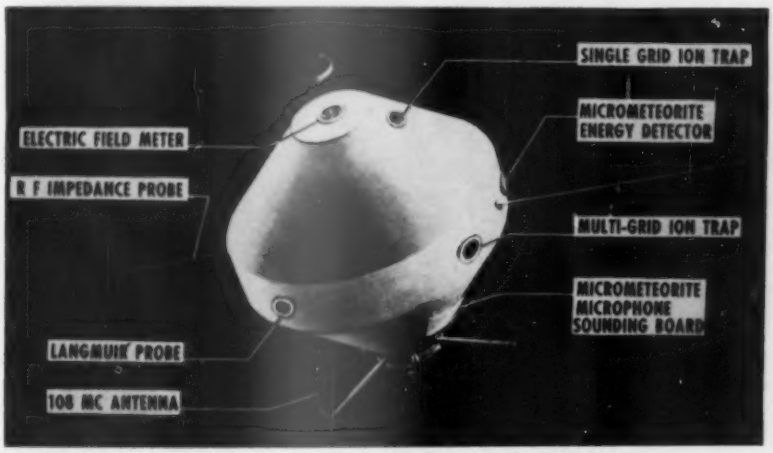
Explorer VIII payload consists of these experiments:

- **Radio frequency impedance** probe, to measure electron concentration 25 times each second. Value will be electron concentration surrounding the satellite to establish the relationship of capacitance to free space data.
- **Single-grid ion trap,** using sensing techniques similar to those used in vacuum tubes to measure ion concentration and mass distribution. Grid is insulated from the satellite skin.
- **Four multiple-grid ion traps,** uninsulated, to evaluate effects of the plasma sheath on ion data so scientists can compare this with data from the insulated single-grid trap.
- **Langmuir probe,** to measure electron temperature.
- **Electric field meter** measuring accumulated charge on the vehicle skin.
- **Micrometeorite photomultiplier** measuring light energy and erosive effects of micrometeorite impacts.
- **Micrometeorite microphone,** consisting of two sound boards to measure the frequency and momentum of micrometeorite impacts.
- **Four thermistors** to measure skin and interior temperature measurements.

Eight packs of mercury batteries are expected to provide power for continuous operation of all but one experiment for three months. The field meter, because of its large power drain, will be operated on ground command six minutes of each 100 min. of orbit. Payload contains a single telemetry/tracking transmitter operating on 108 mc., with a linearly-polarized quadriloop antenna. The satellite is being tracked by the Minitrack network.

The National Aeronautics and Space Administration experiment is managed by Goddard Space Flight Center, which designed and built the experiments. Payload packaging and launch operations were accomplished by Marshall Space Flight Center.

Two final missions remain for the Juno II launch vehicle, both scheduled between February and April next year. Three vehicles, one a backup, are available to launch an orbiting gamma ray telescope, designated payload S-15, and an ionospheric beacon satellite, S-45.



LOCATION of eight experiments in Explorer VIII. Satellite weighs 90 lb.

Space Technology

Rover Advanced to Flight Engine Program

Washington—Success of Kiwi reactor tests has resulted in re-evaluation of the Rover nuclear space propulsion program and a decision to go directly into development of a flight test engine.

Decision by National Aeronautics and Space Administration and Atomic Energy Commission eliminates the planned interim step of an engine preliminary design study, which would have taken at least six months to accomplish.

Invitation for proposals will go to prospective bidders in about a month, with bids expected two months later, and a multimillion dollar research, development and fabrication contract will be awarded about a month after bids are received.

NASA and AEC said proposal requests will be solicited from all qualified contractors. Because reactor fuel will be liquid hydrogen, it is expected that companies with experience in the hydrogen field will be asked to compete for the Rover job.

Potential bidders include Aerojet-General Corp., General Electric Co., Marquardt Corp., Pratt & Whitney Aircraft, Thiokol's Reaction Motors Division, and North American Aviation's Rocketdyne Division.

Most recent Rover test, using hydrogen gas fed at high pressure to fuel the Kiwi-A3 reactor, resulted in a successful full-power, 15-min. run at the Jackass Flats, Nev., test site Oct. 19. Next Kiwi test will be the fourth and will use liquid hydrogen fuel.

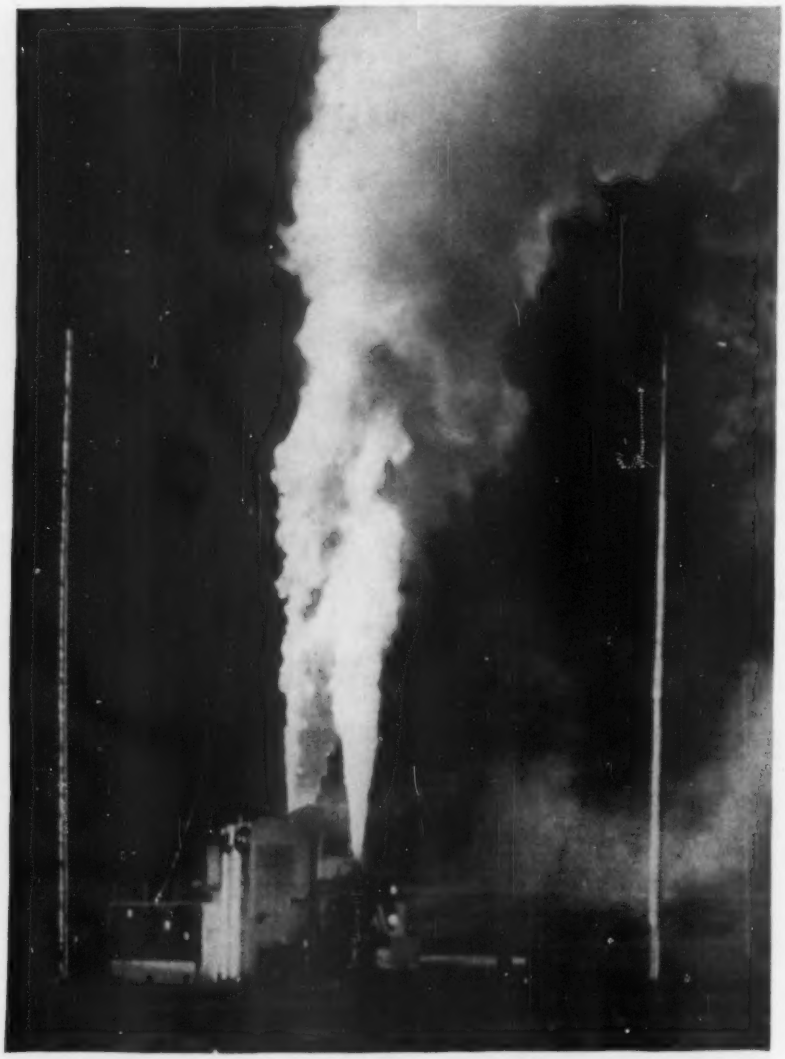
In the active nuclear rocket program, Aerojet-General's Aetron Division won an AEC contract last week for architectural and engineering services for a Rover test stand at Jackass Flats. The downward-firing cell will cost $7-8 million and will be built largely of aluminum alloys. Kiwi tests have been upward-firing for design simplicity.

The Rover nuclear propulsion system is expected to be flight tested as an upper stage of a Saturn vehicle.

Determination to skip the preliminary design study cancels a proposal request issued Aug. 19 by NASA. Six firms responded to the invitation, but no award was made. Program evaluation, and decision to make an early selection of a hardware contractor, were made by the joint NASA-AEC nuclear propulsion office, established Aug. 31.

Change in the Rover program does not affect NASA and industry studies on requirements for nuclear rocket flight testing. In addition to its in-house program examination, NASA has funded separate six-month studies now under way by Lockheed Aircraft Corp. and the Martin Co. on test system design, development programing, test and tracking facilities, safety factors and schedules. Lockheed and Martin studies are part of the Reactor In-Flight Test System (RIFTS).

NASA says a nuclear upper stage has twice the payload-carrying potential of a chemical rocket, and nuclear engines are leading contenders for deep space missions requiring heavy payloads.



KIWI-A3 nuclear rocket reactor is tested at Atomic Energy Commission's Nevada test site. White exhaust plume at right is burning hydrogen gas which is heated to high temperature by uranium-235 which is fissioning inside the reactor. Larger exhaust plume at left, behind reactor, is made by JATO smoke pot; purpose is to aid sampling aircraft in following the hydrogen cloud. This test of the reactor, developed by Los Alamos Scientific Laboratory for AEC and NASA, was made on Oct. 19.

Orbital Test Planned

In the nuclear space propulsion program, AEC develops reactors, and NASA develops the non-nuclear components and assembly.

Nuclear rocket engine is expected to be tested in an earth orbit as the second stage of a Saturn vehicle. Saturn would carry a comparatively low-thrust, low-power nuclear system which would be started after it was in orbit. First flight engine probably will have a specific impulse of about 700 sec., with reactor power of 200 mw.

Liquid hydrogen, heated to gas and accelerated through a nozzle, will provide the propulsive exhaust stream and also will be used for nozzle coolant. Water has been used for nozzle cooling in Kiwi tests, but the next run, with liquid hydrogen as the working fluid, is expected to include a test of cooling with liquid hydrogen.

Nuclear and electric engines (AW

Oct. 31, p. 28) are attractive because of their capability to produce higher specific impulses than all-chemical propulsion systems. Chemical rockets have optimum specific impulses of less than 500 sec.; nuclear engines, about 1,000 sec., and electric engines as high as 10,000 sec.

In long-range mission studies, NASA has translated specific impulses into payload capabilities for planetary exploration. One of these, a round trip to Mars, concludes that a nuclear rocket can carry about seven times the payload of an all-chemical vehicle, and an electric rocket can carry about 10 times the chemically powered vehicle payload.

Nuclear rocket has thrust-to-weight potential approaching one, and NASA is evaluating Rover as a possible booster in the Nova system (AW Oct. 10, p. 26).

Gen. Bradley Urges Correction Of Costly Procurement Mistakes

San Francisco—Air Force and industry still are making too many mistakes in procurement practices, and these must be corrected to comply with congressional orders on cost control and to keep USAF's operational capability from being damaged, Lt. Gen. M. E. Bradley, Jr., deputy chief of staff for materiel, has warned.

Although much has been done in recent months to bring costs into line, USAF still has a number of "problem categories" and is still encountering a "so-what attitude" among some contractors, Gen. Bradley said.

Congress has ordered Defense Department to report by Jan. 1 on improvements made in cost control and has said it will call contracting officers to explain any case where mismanagement was evident.

"The Congress has put us on notice that it expects us to do a far better job of procuring defense hardware," Gen. Bradley said. "Us means you and me—industry and the Air Force. As far as I am concerned, their desire is a direct order—and I and my associates intend to act accordingly." Gen. Bradley's remarks were made in a speech delivered for him before an Aerospace Industries Assn. meeting by Col. A. J. Dreiseszun, chief of the contracts administration branch of the Directorate of Procurement and Production in USAF Headquarters.

Gen. Bradley listed these "problem categories":

• **Over-statement of costs** in incentive type contracts. "In far too many instances for it to be coincidental, target prices in incentive contracts have been too high, and excessive underruns have resulted," Gen. Bradley said. "In some cases, such over-pricing has amounted to as much as 15-20%." This has resulted from contractors' use of "low quantity prices when high quantities would be purchased; from using other than current experience; from anticipating such things as increased labor costs, increased engineering costs, or increased material costs; from anticipating design changes when in fact no such changes were in the offing."

• **Use of unreasonably low target** figures on cost-plus-fixed-fee contracts "in order to get a foot in the door." These low target figures "have resulted in excessive overruns—and the government has often had to pay through the nose for some of its most vital programs," Gen. Bradley said.

• **Decisions on "make-or-buy."** Companies have subcontracted, but often "selected the wrong items to buy and the wrong ones to make," Gen. Bradley said, leading USAF into "some sad experiences." Manufacturers "have tooled up and made components which they could have obtained more cheaply from another source" and "at the same time. . . gone out and bought parts which they could have manufactured at less cost with no unwarranted drain on production or engineering capabilities."

• **Choice of types** of contracts which primes write with subs. USAF carefully studies all circumstances before it decides what type is best for the government to write with a prime contractor—cost-plus-fixed-fee, cost-plus-incentive or fixed-fee-plus-incentive, Gen. Bradley said. "Primes should take the same attitude the Air Force does in these situations," he said. "The decision should be governed not by what the subcontractor wants, but by what is best for cost control and for the government."

• **Use of too many sole source** subcontracts. "Effort on the primes' part—real effort—could in my opinion at least halve the number now being used," Gen. Bradley said. Concentration on competition would cut costs and spread the business. "Then, when you really get down to the point where no competition is practical, two things should be done—really give the cost breakdown a hard look by your best experts, and document the entire situation as to reasons, efforts and actions to protect the interests of the government."

• **Pricing of spare parts.** A change in the method of determining the initial provision of spares has resulted in buying in smaller increments, but pricing of spares still is "a subject of great concern," Gen. Bradley said. "What I have said about overpricing with regard to fixed price and cost-plus-incentive contracts for weapon systems applies equally to spares," he said.

• **Contractor attitude.** Some are making all-out efforts to reduce costs, but others "take the so-what attitude and do nothing," Gen. Bradley said. "I'm not trying to preach ethics or patriotism," he said, "but I do want to go on record as saying we can identify those that are cooperating and those that are not."

Discussing steps that USAF is taking to correct these problems, Gen. Bradley said a close look is being taken at performance of companies with cost-plus-fixed-fee contracts to "insist that target costs be much more realistic." "Score sheets" will be compiled to see whether an individual contractor "consistently overruns on cost-plus and underruns on incentive," he said.

On fixed-price-plus-incentive and cost-plus-incentive contracts, "we are going to take a close look to find out whether or not excessive underruns are apparent." USAF will insist "even more vigorously" that incentives are earned on the basis of improved management and engineering and not as a result of overstated prices, Gen. Bradley warned.

Contract Changes

Several changes in incentive contracts are being tried to include such factors as meeting delivery dates, improving performance criteria and increasing reliability, rather than simply saving dollars, he said.

USAF also is considering injecting value analysis clauses into contracts. Using a company's definition, Gen. Bradley described value analysis as "the process of studying objectively every item to be purchased, standard or special, and eliminating every cost factor which does not contribute to the value or usefulness of the item."

To improve its own contracting procedures, USAF last summer reduced contract management from nine Air Materiel areas to three centralized regions, reducing manpower "while actually improving our ability to manage," Gen. Bradley said. It also has taken steps to better educate procurement officers in pricing and contract administration.

He asked industry "to do some soul and corporate body searching—and take action to help in the all-out cost control drive." Progress is being made by both sides now, the general said, "but I am absolutely sure there is room for more belt tightening. That is what I am now asking for."

Boeing-Vertol 107 Model II Makes First Flight

Boeing-Vertol 107 Model II makes its first flight outside Boeing Vertol Division's Plant 1 at Morton, Pa. In-rig. ground and stability tests, airborne resonance tests, hover and slow forward flight tests have been made for a total of more than 10 flight hours. The converted YHC-1A is presently being prepared for five hours of in-the-field flight testing at Boeing-Vertol's Plant 2 at Philadelphia International Airport. Purpose will be to obtain strain gage data on rotor blades. Gas turbines are two General Electric CT58-100s each rated at 1,050 shp.; dynamic system is uprated to 2,500 shp. (AW Sept. 26, p. 23).

Advisory Procurement Role Urged For Business and Labor Agencies

Washington—Advisory participation by Commerce Department, Labor Department and the Small Business Administration in military procurement—in view of its vast impact on the national economy—is urged in a Joint Congressional Economic Committee's defense subcommittee report.

Noting that military procurement over the Fiscal 1950-1959 period totaled over $228 billion, the subcommittee, headed by Sen. Paul Douglas (D.-Ill.), commented:

"The use of the great military expenditures as an economic tool has not fully been exploited. Though there are areas of chronic economic distress in many states, the state of California, in Fiscal 1959, received 24.3% of the total, or as much of the procurement dollar as the next four largest recipient states and as much as the 37 smallest recipients."

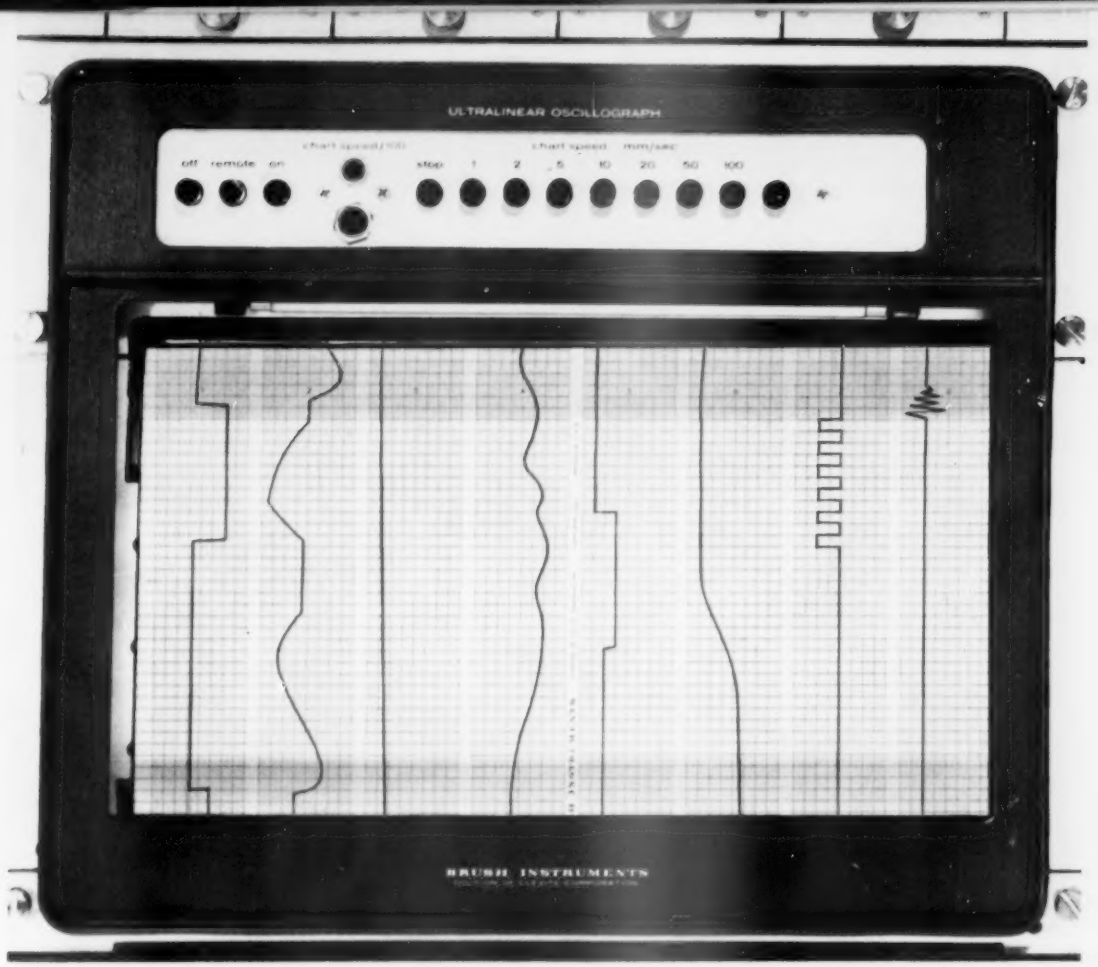
The subcommittee also recommended that Commerce Department be given "definite authority of approval" over Defense Department surplus property disposals, estimated at $8-10 billion annually, with a net return on sales of less than 2%. "Many of the sales have a serious impact upon portions of the economy, yet the Commerce Department, which is charged with responsibility of aiding, fostering and assisting business, is in an advisory position to Defense Department with respect to the conduct of surplus sales," the report said.

In the patent field, the subcommittee called for uniform legislation applicable to all government contracts and "based upon the principle that government expense creates government property." Since the major portion of military procurement is by negotiation, rather than the fully competitive, free enterprise concept, the subcommittee observed, "it is apparent that subjective decisions by procurement officers have a heavy impact for good or ill upon the national economy. . . . It must be concluded that public expenditures are creating vast new public domains which should be made available under government direction to all as a matter of right and for the expansion of our economy."

The subcommittee proposed establishment of a "consolidated agency" in the office of the Secretary of Defense to manage all common supply items and activities. This would include transportation—but not Military Air Transport Service which has a military strategy role—and components used in end items by cost-plus contractors, as well as the military agencies.

The consolidated agency, the subcommittee said, "should have control of all facets of common supply management from requirements determination through procurement, transportation, storage, issuance, utilization, and surplus disposal."

In a statement accompanying the report, Sen. Douglas and Rep. Thomas B. Curtis (D.-Mo.), ranking minority member of the subcommittee, estimated that "billions of dollars" could be saved through the consolidated management, more extensive use of competitive bidding, "a genuine standardization program to substantially reduce the millions of items now valued at over $44 billion in the supply systems, and . . . a real utilization program with centralized authority . . . so billions of dollars' worth of excess property were used, or made to do, and not declared surplus while the same or like items are being purchased by other agencies."



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KNOW YOUR ALLOY STEELS . . .

This is one of a series of advertisements dealing with basic facts about alloy steels. Though much of the information is elementary, we believe it will be of interest to many who may find it useful to review fundamentals from time to time.

Determining the Depth-Hardness of Alloy Steels

The hardenability of an alloy steel is usually measured by the depth to which the steel will harden under specific conditions of heating and cooling. One of the most conclusive methods of determining depth hardness is the end-quench hardenability test (ASTM A255). In essence, this test is as follows:

A 1-in. round specimen, approximately 4 in. long, is heated uniformly to the proper quenching temperature. The specimen is removed from the furnace and placed in a bracket; then a jet of water at room temperature is played on the bottom face of the specimen without touching the sides. This water jet is kept active until the entire specimen has cooled. Longitudinal flat areas are ground on opposite sides of the piece, and Rockwell C readings are taken at 1/16-in. intervals. The resulting data are plotted on graph paper, with the Rockwell C values as ordinates and distances from the quenched end as abscissae.

Experiments have shown that the points on the hardenability curve approximate the cooling rates at the centers of quenched rounds of various sizes; and that the hardness values at the centers of these rounds will correspond very closely with those shown at points on the end-quench hardenability curve.

In general it may be said that when end-quench curves for different steels approximately coincide, these steels can be treated similarly for equivalent tensile properties in sections of the same size.

A study of hardenability curves reveals that depth-hardness depends upon the amount of carbon present, the alloy content, and the grain size. Manganese, chromium, and molybdenum are the chief elements that promote depth-hardness, while nickel and silicon help to a lesser degree. It should be noted, also, that phosphorus promotes depth-hardness, while sulphur has a negative effect. In normal low-phosphorus and low-sulphur steels, the two elements neutralize each other.

This series of alloy steel advertisements is now available as a compact booklet, "Quick Facts about Alloy Steels." If you would like a free copy, please address your request to Publications Department, Bethlehem Steel Company, Bethlehem, Pa.

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Alitalia, SAS, Swissair Plan DC-8 Retrofits to Boost Nonstop Range

By Cecil Brownlow

Geneva—At least three European Douglas DC-8 jet transport operators—Swissair, Scandinavian Airlines System and Alitalia—are planning major retrofits during the passenger-slack winter season to boost the aircraft's range and ensure nonstop transatlantic flights under all conditions.

Specific fuel consumption of DC-8s delivered to the airlines thus far is higher than the guarantees originally established by Douglas and make intermediate stops necessary on westbound flights with high payloads against strong winds.

SAS and Swissair DC-8s are powered by Pratt & Whitney JT4A engines; Alitalia's by Rolls-Royce Conway bypass turbojets.

Swissair, in its winter schedule beginning Dec. 3, is dropping all thoughts of nonstop jet flights to New York, funneling its DC-8s through Lisbon, a regular terminal, and Shannon, Ireland. Refueling flights through Shannon will be abandoned next summer after the initial step in Swissair's retrofit campaign has been fully completed.

SAS and Alitalia are continuing to schedule nonstop flights from Copenhagen and Rome to New York but program in refueling landings at Prestwick, Scotland, and Gander, Newfoundland, respectively when high load factors and adverse weather conditions dictate.

Fourth Operator

A fourth European DC-8 operator, KLM Royal Dutch Airlines, said last week that the reduced range has not affected the nonstop schedule between Amsterdam and New York, which at 3,634 stat. mi. is slightly shorter than the 3,922 mi. between Zurich and New York and the 3,845 mi. between Copenhagen and New York.

A KLM spokesman said the airline is "extremely satisfied" with the aircraft's performance and passenger appeal to date.

Swissair and SAS, whose jet maintenance programs are closely coordinated, will conduct the DC-8 retrofit program on a joint basis.

First step, to begin around the first of next month during regular major overhaul cycles at Arlanda Airport near Stockholm, will be the installation of additional fuel tanks along the leading edge of the DC-8 wing capable of carrying approximately 950 U. S. gal. of fuel. The installation will add an estimated 2.3 tons to the aircraft's over-all weight, but Swissair spokesmen say this will not necessitate any decrease in DC-8 payloads.

Cost of the retrofit for Swissair's three DC-8s and SAS's seven, which should boost the range to company guarantees, will be largely borne by Douglas.

Second step, planned for the 1961-1962 winter season, calls for modification of the aircraft to conform with recent Douglas proposals in which the leading edge of the wing is sharpened and wing chord is extended 4% along the entire span to improve range, speed and payload (AW Oct. 24, p. 41). Douglas estimates that the modification will increase the DC-8's specific range by as much as 8%.

Cost, estimated at between $200,000 and $300,000 per aircraft, probably will be met by the two airlines if the initial fix succeeds in extending the aircraft's range to meet or exceed company guarantees.

Swissair will begin rescheduling nonstop transatlantic flights next summer, although all but two of its planned 14 weekly round trip flights to New York will still stop at Lisbon, a major traffic source for the airline during the tourist season.

Alitalia plans to begin immediately to modify the wings of the three DC-8s it now has on hand. Work on the first aircraft to be pulled from service is scheduled to get under way next week in Alitalia's maintenance headquarters at Rome's Ciampino Airport. An additional five DC-8s on order by Alitalia will be delivered with the modified wing installation already in place.

News Digest

Continental Motors Corp. and Rolls-Royce, Ltd., have signed a license agreement giving Rolls-Royce exclusive rights for the sale of all Continental aircraft piston engines and spares in Europe, and for Rolls-Royce-built Continental engines in Australia and New Zealand.

North American T-39 twin-jet utility trainer has arrived at Eglin AFB, Fla., for all-weather testing in Air Proving Ground Center's climatic laboratory.

Aeronca Manufacturing Corp. plans to acquire, through an exchange of stock, a controlling interest in Flight Refueling, Inc., a Baltimore company involved in the production of fueling equipment and in the development of missile and nuclear components. Proposed acquisition has already been approved by the directors of both corporations and now must be approved by Flight Refueling stockholders.

Northern Ordnance, Inc., has a $20.4 million contract for added production of Mk. 10 Terrier missile-launching system, to be installed on ships in the Fiscal 1961 shipbuilding program.

Fairchild Engine & Airplane Corp. has a $1,083,530 contract for continued work on the SD-5 Drone surveillance system.

Dr. Edward R. Sharp, 66, who supervised construction of Ames and Lewis Laboratories for the National Advisory Committee for Aeronautics, will retire at the end of this year as director of National Aeronautics and Space Administration's Lewis Research Center. Sharp has 45 years of service with the Navy, NACA and NASA.

Aetron Division of Aerojet-General Corp. has been selected architect-engineer for Saturn static test facility at Marshall Space Flight Center. Construction contract for the $10.8 million stand will be awarded in seven months.

Martin Co.'s Research Institute for Advanced Studies and Air Force launched a 200 ft. balloon carrying a 100 lb. double ionization chamber and telemetry package from Holloman AFB, N. M., to a 112,000 ft. altitude in a program to count and determine origin and variations of heavy cosmic rays.

TWA Jet Financing

Trans World Airlines owner Howard Hughes still was seeking alternative financing last week for TWA's jet program. After a series of daily meetings the week before, TWA's board met again last Monday and then adjourned with no further special meetings scheduled.

Trans World Airlines is technically in default on equipment mortgage bonds held by the Equitable Life Assurance Co. and in default on a $27-million short-term bank loan from a group of banks headed by the Irving Trust Co. originally due Aug. 1 but extended to Sept. 1. Banks have begun to offset TWA cash balances to effect payment (AW Oct. 31, p. 35).

Creditors have reportedly set three previous deadlines for action by Hughes, but all have gone by the board. No formal deadline is believed to exist now, but reports in New York financial circles indicate time is getting short.

Jet Impact Felt in Transatlantic Market

Scheduled summer capacity exceeds million-seat mark for first time; off-season predictions optimistic.

By Glenn Garrison

New York—Transatlantic scheduled airlines, throwing their new jet fleets into the vigorous North Atlantic competition, carried about 859,000 passengers on the route last summer. This was a 24% increase over the same June through September peak season period of 1959.

Scheduled capacity for the summer passed the million-seat mark for the first time with a total of 1,257,000 seats for the period. This was a 31% increase over summer, 1959, and gave the carriers an over-all passenger load factor in both directions of 68%.

In the 1959 season, with most of the airlines waiting for their jets, summer capacity rose only 4% over the previous season and load factor was 73% (AW Dec. 7, 1959, p. 36). For the first time last summer, the tremendous impact of the jet capacities was being felt.

Even so, the increase in seat capacity was less than the increase in summer, 1958, first season of the economy fare and a period when the carriers were filling out their late-model piston fleets. That summer's capacity increase was 40%, and the traffic was up 33%.

The booming 1960 summer business filled a profitable percentage of the offered seats, but many airline officials feel that the off-season months ahead will provide a severe test of the carriers' ability to satisfy their jets' appetite for traffic. Based on bookings to date and expected stimulus from the new off-season excursion fares, the carriers are showing optimism.

Traffic for the first nine months of 1960, however, was running somewhat below the airlines' predictions earlier this year, which indicated a 1960 passenger total close to the two million mark (AW June 27, p. 43). Actual January through September total was 1,368,000 scheduled passengers, up 25% from the same nine months of 1959. Charter passengers carried by the International Air Transport Assn. airlines during the 1960 period totaled 133,000, for a grand passenger total of 1,501,146. During the last three months of last year, the scheduled passenger total was 276,000, so the remainder of 1960 would have to show a tremendous increase to touch two million for the year.

Total scheduled capacity for the nine months was 2,037,000 seats, a 25% increase, resulting in an over-all load factor for the period of 67%.

The IATA carriers boosted their summer charter business 19% to a total of 95,700 passengers, getting mileage this way with their displaced piston equipment and sandwiching jet charters in between their scheduled jet flights.

Scheduled passengers in the economy class alone totaled 1,119,000 for the nine months of 1960—an impressive figure considering that 1957 was the first year the transatlantic carriers topped the million point for the entire 12 months. First class passengers for the 1960 period totaled 239,000 and the tourist class, which expired last June, accounted for 10,147 passengers during the six months of 1960 in which it was operative.

The carriers report big increases in bookings for the next couple of months and express high hopes for the 17-day, reduced-fare excursion plan which became effective Oct. 1. This off-season fare will be subject to review by the IATA airlines next March.

Some officials have reservations about this plan, however, particularly the time period, which they feel should be longer. Nevertheless it is considered a forward step in exploiting the off-season potential and is credited with being a big item in the sharply increased bookings recorded by the airlines.

Carriers' Figures

Here are some individual summer results and off-season predictions among the IATA North Atlantic carriers:

• **Air France's** traffic increased 17% to 54,000 passengers for the period. Peak weekly eastbound capacity was 3,042 seats, up from 2,185 seats in 1959. The 1960 seats were all-jet in Air France's Boeing 707-320s, which went into service last February. The airline operated 18 round-trip charters during the summer period, all but one of them in jets. Charters during summer, 1959 totaled 12 in Lockheed 1649A and 1049 equipment. In October, November and December of 1959, Air France carried about 14,000 passengers on the route, and expects this total to jump almost 1,005 this year to 27,000 passengers. The new fare is cited as the major reason.

• **Air India** began service May 14 with Boeing 707-420s, carried 6,301 passengers during June, July and August. Three flights a week are offered in 102 economy, 28 first-class aircraft configuration.

• **Alitalia** carried about 30,000 passengers during the summer between Europe and New York, Boston and Montreal. The increase was 49% over summer, 1959. Capacity was up 54%. About 50% of the airline's summer capacity this year was in its Douglas DC-8 jets, with all-jet service beginning Aug. 1. Eleven eastbound jet flights replaced the 13 weekly DC-7C flights of last summer, illustrating the increased unit capacities and production of the jets. Alitalia operated six eastbound charters during the period, all in DC-7C equipment. Since the excursion fare went in, about 35% of Alitalia's eastbound passengers held this type of ticket.

• **British Overseas Airways Corp.** carried 133,475 passengers, up 19%. Peak week capacity was 12,828 seats, up 33%. The capacity was offered in 131 flights, 73 of them Boeing 707-420 and de Havilland Comet 4 jet flights and the other 58 Bristol Britannia turboprop flights. This compares with 127 weekly flights at the 1959 peak, of which 54 were piston flights. BOAC flew about 100 round-trip charters during the season, three quarters of which were piston aircraft. Most of the remainder were in Britannias except for "at least one" jet charter. Bookings for October were up 50%, BOAC reports.

• **KLM Royal Dutch Airlines** carried 61,900 passengers across the North Atlantic during the June-through-September period, up from 51,965 passengers. Peak week eastbound capacity totaled 3,474 seats from New York, Houston and Montreal, up from 2,826 seats in 1959. The increased capacity was offered in 35 weekly flights as opposed to 38 flights in summer 1959 at the peak. The airline began operating DC-8s last April. KLM is traditionally a heavy charter operator, but does not disclose figures.

• **Lufthansa German Airlines** used a jet fleet of three Boeing 707-420s and carried 49,126 passengers during the summer, operating 12 weekly round trips and serving New York, Chicago and San Francisco via Montreal. Some

FIRST of three Boeing 720s ordered by Irish International Airlines takes off on initial flight from Renton Municipal Airport, near Seattle, Wash. Irish International plans to start transatlantic jet operations from Dublin and Shannon to New York and Boston on Dec. 14, carrying 16 first class and 101 economy class passengers. The Irish 720s are powered by four Pratt & Whitney JT3C7 turbojet engines.

extra sections were flown in piston equipment. The 1959 summer total was 33,661 passengers. The German carrier's Super G and 1649A Constellations found employment in 144 charter legs, an increase from 12 charter legs in the summer of 1959. The 12-round-trip schedule is still in effect and Lufthansa says off-season bookings are "way up."

• **Pan American World Airways** carried 135,306 passengers during the four months, up from 128,768. During a peak week, PanAm offered about 11,599 seats in both directions, up from 9,721 seats in 1959. About 90% of the 1960 seats were in jets. The airline says bookings are up for the off-season, but it is becoming increasingly difficult to forecast several months ahead in the winter months. One reason: trend is to bookings a shorter time in advance as people grow more casual about transatlantic travel. Another factor is the fact that there will be a lot of jet capacity offered this winter and space need not be booked so far ahead. Lower fares are another factor; the vacation travelers don't have to save up so far in advance. Result of these factors is that trips in general aren't planned as far in advance as they used to be. Pan American expanded a special passenger service program last summer aimed partly at combating the no-show problem at Idlewild. Sales representatives worked in shifts at the PanAm terminal, making last-minute checks of loads on Europe-bound flights both on PanAm and other carriers. Passengers desiring to take their chances by showing up without specific reservations were steered to the terminal and the representatives worked at finding space. In the case of flights with no-shows, of course, the potluck passengers provided a nice top-off. In some cases the passengers accepted flights, say, from New York to London via a connection at Paris, which the on-the-spot sales representative was able to aquaint them with. In other cases, the representatives —in close touch with other airline departures—would get them space on another carrier, booking back by PanAm with PanAm picking up a commission on the eastbound flight. Pan American assigned seven sales representatives to this service and they handled more than 700 passengers in one four-week period.

All except about 24 were placed aboard Pan American flights. PanAm's charter business for the summer totaled 10,267 passengers in both directions, up from 6,502.

• **Qantas Empire Airways** carried 5,921 passengers on its one-way route across the North Atlantic, up from 4,721 passengers in summer, 1959. Frequencies were two weekly in 707-120 equipment, with a 64 first class, 120 economy configuration.

• **Sabena Belgian World Airways** carried 21% more passengers than the 29,966 carried during summer, 1959. The airline was out of transatlantic service for a period during the summer when it participated in the Belgian Congo airlift of refugees. During the period July 10-22, Sabena turned over 2,854 eastbound transatlantic passengers to other airlines. Sabena began 707-320 service last January. Peak weekly eastbound capacity was 2,196 seats, up 38% from peak 1959 weekly capacity. The airline operated six charters during last summer, all of them in jets.

• **Scandinavian Airlines System** carried 55,258 passengers, up 25% from the previous summer. Over-all capacity was up 23%. With DC-8 jets going in last May, average weekly flights dropped from 29 to 22 despite the capacity boost. SAS operated 67 charter legs with a total of 5,540 passengers, up from 25 charter legs and 2,000 passengers in summer 1959. Six of the 1960 charters were flown in DC-8s, the rest in DC-7C piston equipment. SAS reports considerable interest in the 17-day excursion plan. Regarding bookings this year, the forecast for November and December is about 50% up from those months of last year. October passengers, the airline said, will total about 122% more than last October.

• **Swissair** carried 27,625 passengers last summer, up from 21,874. The airline's DC-8 jets entered transatlantic service May 30, and schedules on the run are now all-jet. Swissair handled six charter round trips, two of them in DC-8s. In summer, 1959, the charter total was 14 round trips, all in DC-7Cs. Bookings for the off-season are up considerably, the airline said, due chiefly to the excursion fare.

• **Trans World Airlines** carried 122,859 passengers, up 60% from the previous summer. This was TWA's first summer with its 707-320 jets on the Atlantic. Flights for the period totaled 1,532, down from 1,556. The 1960 flights were 79% jet. Peak week capacity rose 91% last summer to 12,231. Traffic in October was up 75% over October, 1959. Bookings are up 80% for November and 60% for December, the airline reports. TWA flew 144 charter legs during last summer, down from 540 during the previous period, when the airline was handling a giant Military Air Transport Service contract.

Trans-Canada Air Lines inaugurated transatlantic jet service June 1 with its DC-8s. Four transatlantic carriers have not yet begun jet operation: El Al Israel, with Boeing 707-420s ordered for delivery next year; Canadian Pacific, expecting DC-8s next year; Iberia, expected to receive DC-8s next year; and Irish International Airlines, now receiving Boeing 720s for expected inauguration of service Dec. 14.

American May Take CAB to Court To Fight Service Adequacy Order

By L. L. Doty

Washington—American Airlines' current drive to develop the latest of Civil Aeronautics Board adequacy of service decisions into a legal test of how far the Board can go in monitoring schedules may move into court.

Case at stake is the Ft. Worth Investigation, in which American was told by the Board to establish at least one round trip turbojet schedule daily between Ft. Worth and New York and one round trip daily turboprop schedule between Ft. Worth and Washington. The Board also said it would retain jurisdiction over the service for an indefinite period (AW Sept. 26, p. 39).

The carrier filed a petition for reconsideration (AW Oct. 24, p. 41), and the Board stayed the effective date of the order pending investigation of the petition. An earlier adequacy order, in the Washington-Baltimore case (AW June 20, p. 91), has been stayed until Dec. 15 because a number of petitions for reconsideration were filed.

If the Board upholds its original order in the Ft. Worth Investigation, American will take the case to court. Last summer, Capital Airlines took a similar action when it appealed a Board decision calling for increased coach service in the Toledo market (AW July 18, p. 43).

A U. S. Court of Appeals upheld the Board on grounds that the Board will be "increasingly concerned with securing adequate service for smaller, intermediate cities" as major trunkline routes attract heavier schedule frequencies. Capital did not appeal the court decision because it felt its case was not strong enough to risk establishing a legal precedent which might have a bearing on cases of greater importance to the industry in the future.

The Capital case brought into the open the two widely divergent views held by industry and the Board on adequacy of service. Industry's position is that there is no yardstick that can logically be used to determine the amount of coach service or any other type of service, in all markets under all operating conditions, while the Board continues to show every sign that it is prepared to set coach standards in trunkline markets.

In the Ft. Worth Case, American will argue that the Board has no legal authority to dictate the type of equipment a carrier will use to serve any market, nor does it have the power to prescribe standards concerning adequacy of service in any market.

In its legal challenge of the Board's decision in the Ft. Worth case, the carrier states that Section 404 of the Federal Aviation Act provides that every air carrier shall provide adequate air transportation according to the terms of its certificate and points out that this is the only mention of adequate service.

In 1937, Congress proposed a bill which would have empowered the CAB to revise "from time to time, general standards respecting the character and quality of service to be rendered . . . and to make such standards effective on such dates as it may determine after due consideration of the time required to conform to such standards."

However, Congress did not enact the bill, but it did pass this provision in the 1938 Civil Aeronautics Act, on which American bases part of its case:

"No term, condition or limitation of a certificate shall restrict the right of an air carrier to add or change schedules, equipment, accommodations, and facilities for performing the authorized transportation and service as the development of the business and the demands of the public shall require."

Thus, American argues that the CAB can determine—after due notice and a hearing—whether service is adequate and, if not, in what respect it is inadequate. But the carrier maintains that the CAB cannot, by virtue of having held a hearing, issue orders which command an airline to change schedules.

The airline is prepared to cite a number of cases in which the Court of Appeals has ruled that the CAB is not to assume or exercise powers which it has not been granted by Congress.

American charges, on the basis of such decisions, that the Board is exceeding its statutory authority and intruding itself into management functions by dictating not only standards of adequacy but specific types of service to be performed, as in the Toledo Investigation, routing to be employed, as in the Washington-Baltimore Investigation, and types of equipment that must be used, as in the Ft. Worth Investigation.

In the Ft. Worth case, the Board issued a decision in 1958, after several years of investigation and due notice and hearing, finding the air service to be adequate. American claims that the Board's subsequent finding of inadequacy without another hearing within a year of its original decision was not within its legal authority. The airline observes that even Ft. Worth has protested the unfairness of "arbitrarily" ordering one of two carriers—Braniff is the other—to use specific equipment on a specified minimum schedule frequency.

American also will hold that continuing jurisdiction over this and other cases will result in a deterioration of CAB efficiency in what the airline feels is a legitimate sphere of the Board's operation. The carrier believes that, at a time when CAB workloads are at an all-time high, the agency has embarked on a new regulatory policy which is calculated not only to encourage new litigation but also to saddle the Board's staff with the complicated business of second-guessing airline scheduling policy.

In the economic area, American will warn that any attempt to inject CAB's regulatory role into management functions in the scheduling of aircraft will threaten serious economic repercussions, particularly during the transition to all-jet operations.

An American spokesman pointed out to AVIATION WEEK that scheduling is a crucially important factor in maintaining economical operations and adequate financial returns. He said that overscheduling, over a period of months, can inflict "crushing financial losses and jeopardize the approximately four billion dollars the industry will have invested in jet equipment." He added:

"What constitutes overscheduling is a complex and changing problem which requires day-to-day supervision of airline experts conversant with all aspects of airline operations. The customary difficulty and complexity of balanced scheduling has been greatly increased by the faster, larger capacity jet aircraft."

American believes that scheduling must be supervised by the people who have a financial stake in the company, not by a government employe who may have no business experience and little concern with financial outcome.

Seaboard Reshuffles Management

New York—Top management reshuffle has taken place at Seaboard & Western Airlines, now engaged in a major refinancing program (AW Oct. 24, p. 41). Richard M. Jackson, who joined Seaboard & Western last July on the recommendation of the underwriters and has been acting board chairman and general manager, becomes president and chairman of the board.

Seaboard sold to Carl M. Loeb, Rhoades & Co., acting as underwriter, $1,595,000 principal amount of 6% subordinated debentures due July 1, 1970.

Raymond A. Norden, former president of the airline, and Arthur V. Norden, former executive vice president, will serve the carrier as consultants. A new board of directors has been appointed.

Delta Wants to Resolve Idlewild's Jet-Noise Complaint Out of Court

New York—Delta Air Lines has changed its mind about making a test case of a Port of New York Authority court action to restrain Delta from violating anti-noise procedures at Idlewild (AW Oct. 31, p. 36).

The airline's first reaction to the complaint, filed last month in the Supreme Court of the State of New York, was to let the issue be resolved. Last week Delta told AVIATION WEEK that upon reconsideration it had decided it did not want to make an issue of the case and hoped to work out an amicable arrangement with the Port Authority which would lead to withdrawal of the complaint. Compliance with the procedures would be easier to accomplish, the airline said, now that Daylight Saving Time has ended and the night Convair 880 flight which drew specific Port Authority criticism has been rescheduled from 10 p.m. to 9 p.m. (Noise complaints increase at nighttime.) Also, shakedown problems with its new 880s would be fewer now that the fleet has reached seven aircraft, with five more to arrive by fall, 1961, Delta said.

The Port Authority last week had "nothing to add" to its previous announcement concerning the complaint and Delta's alleged violations.

One reason Delta wants to soft-pedal the controversy is its relationship to possible jet operation at Newark Airport. Delta is anxious to begin 880 service at that airport, where scheduled jets still are not permitted. Delta is the only airline which has officially asked permission to operate jets at Newark on a scheduled basis.

In a letter to Delta last August, the Port Authority chided Delta for "continuing unsatisfactory performance" at Idlewild and reminded the airline that the record of 880 operation at Idlewild would affect a jet decision at Newark.

The Port Authority has been postponing a decision on jets at Newark for some time. The agency faces a grave political problem there and speculation has been that a move might be made some time after general elections.

Last spring, the agency asked Delta to submit flight profiles on its 880 and subsequently advised the airline that ". . . we will be able to evaluate fully the operating and noise characteristics of this aircraft as they might relate to Newark Airport only after we have had an opportunity to observe the Convair 880 in regular commercial operation at New York International Airport for some time." Delta inaugurated 880 service at Idlewild last May.

In its letter to Delta, the Port Authority pointed out that New Jersey Governor Robert Meyner had expressed opposition to operation of jets at Newark ". . . largely because of the record of nonconformance with Port Authority jet noise abatement procedures by some airlines at New York International Airport." The agency said the 880's record at Idlewild might be "of particular significance in any future decision on jet operations at Newark."

Biggest airline user of Newark is Eastern, which normally operates more than a third of its New York schedules at the airport. Eastern is negotiating with the Port Authority for construction of a $5 million hangar at Newark and final plans await a decision on jet operation.

Eastern operates 102 flights daily in and out of Newark, handled 600,000 passengers at the terminal last year. In a recent article for the Newark Assn. of Commerce and Industry, E. V. Rickenbacker, chairman of Eastern's board, wrote optimistically of Newark Airport's future and predicted development of jet aircraft and operational procedures will be "entirely acceptable to the community and our airport neighbors."

Commercial jets have been going into Newark for some time when weather diverts them from Idlewild. As of Sept. 27, there had been 129 jet diversions to Newark. The aircraft are ferried back to Idlewild. Trans World Airlines informally asked the Port Authority for permission to operate these diverted flights as revenue departures, but the airline was turned down.

Community complaints regarding noise at Newark have not reflected concern with the jet movements there so far. At the Sept. 27 point, only one complaint was traceable to specific jet operations at the airport, the Port Authority said.

Something of the Port Authority's political problem at Newark and its position so far can be seen in an exchange of letters between the agency and U. S. Rep. George M. Wallhauser (R.-N. J.). Wallhauser wrote the Port Authority earlier this year of his concern with reports of the possibility of installation of runways for jet operations at Newark and expressed the hope that ". . . you will be able to reassure me that there is no substance to the various rumors and theories concerning this entire project . . ."

The Port Authority replied that jets are not now permitted at Newark on a scheduled basis and made the following explanation of future policy:

"It is true that transport aircraft propelled by piston engines are no longer being manufactured. Nevertheless, with respect to any request from an airline to permit scheduled jet operations at Newark Airport, before our board would even consider the matter it would first be necessary for our staff to evaluate the proposed flight operation procedures. We would then observe the actual conduct of such operations at airports other than Newark to determine the noise levels resulting from the proposed procedure. If the noise levels would prove to be excessive in the communities adjacent to Newark Airport, we, of course, would not recommend to our board that it consider granting such a request."

The Port Authority is going ahead with improvements at Newark Airport, including a $100,000 self-claim baggage area, runway and taxiway resurfacing, additional runway approach lighting, and parking lot expansions.

It seems reasonable to assume that the agency would not be investing considerable funds in the airport if its role was to be sharply curtailed, as it would be in the future if the airlines couldn't operate their smaller jets at the field.

FAA Grounds Airline

Washington—Federal Aviation Agency issued an emergency suspension order last week to Arctic Pacific, Inc., following the crash of the supplemental carrier's C-46 transport at Toledo, Ohio. The pilot and copilot and 20 passengers were killed and 26 persons survived.

Suspending the carrier's operating certificate, FAA Administrator E. R. Quesada said "I am clearly of the opinion that an emergency, requiring immediate action, exists in respect to safety in air commerce. . . ." Certificate of the pilot of the C-46, Donald L. J. Chesher, had been revoked by the FAA last July, but an appeal by the pilot resulted in a stay by CAB pending a decision in the case.

More Caravelle Orders

Paris—Air France last week was expected to announce an additional order for twin-jet Sud Aviation Caravelle transports. The number of additional Caravelles reportedly is six, as predicted in Aviation Week (Mar. 21, p. 45).

Another two Caravelles were ordered last week by Sabena Belgian World Airlines, raising its total order from four to six of the planes. Deliveries are expected to begin next January.

An Air France order of six Caravelles would raise its fleet total to 30. Speculation here last week was that the new order will be made under a pooling arrangement with other Air Union carriers.

British Aircraft Corp.'s Mach 2.3 Transport Study Contract Extended

By John Tunstall

London—British Aircraft Corp.'s $1 million design study contract for a Mach 2.3 airliner amounts to a 12-month extension of the feasibility study submitted to the Ministry of Aviation in March and will involve some wind tunnel testing.

The announcement, made by Peter Thorneycroft, minister of aviation in the House of Commons, in a written reply, makes no reference to the status of feasibility studies submitted by the Hawker Siddeley Group. The feasibility studies submitted by both groups to the Ministry were based on largely similar slim delta configurations. Only Hawker, however, submitted a Mach 2.7 project in stainless steel, although it made no strong recommendations for the immediate development of the steel aircraft and also submitted a Mach 2.2 light alloy project.

Contract's Significance

Although the contract signifies abandonment of the Mach 2.7 aircraft because of the structural research program which the switch to steel would involve, the allocation of the contract to BAC does not mean that BAC will act as prime contractor for any further development of the aircraft.

Both groups believe that if the government should order the aircraft into production, or build a prototype, the design and development and production contracts would be allocated throughout the industry.

A feature of the present design contract which is still being negotiated is a condition requesting British Aircraft Corp. to "explore further, with appropriate companies overseas, the possibilities of collaboration with a view to the sharing of costs and a widening of markets."

The condition is regarded here as inferring that the government still does not contemplate proceeding with the production of the airplane on its own.

Configuration Open

The engines and thrust configuration are believed to be still wide open. Bristol Siddeley Engine Co. appears most favorably placed to power the craft. But Rolls-Royce is expected to make a strong bid with a Conway 42 development. One contender is the Bristol Siddeley Olympus Mk.21, a proposed development of the Olympus line with a net dry thrust of about 30,000 lb. This is the largest engine envisaged for the aircraft. Alternatively, but involving use of a greater number of engines, is a version of the Olympus now being developed for TSR.2, the supersonic strike aircraft. Bristol Siddeley is also proposing an aft fan version of an Olympus primarily for the Vickers Super VC.10 and, according to one Bristol source, this would have possibilities for supersonic aircraft.

There is also the possibility of a mixed powerplant for the aircraft using ramjets and turbojets.

Award of the contract to BAC did not come as a great surprise to the industry and it is generally regarded here that the newly reinforced research and wind-tunnel facilities of BAC are superior to those available to Hawker Siddeley. Most of the British supersonic know-how also resides with BAC.

There is also the possibility that both the TSR.2 and the proposed supersonic airliner have similar delta configurations, which would be another powerful factor influencing the placing of the contract.

Work is known to have been proceeding at the Bristol Aircraft Co.'s Filton works on a slim delta study for some time and there had been much unexplained expansion of the company's design team under Dr. A. E. Russell and the design offices.

Some sources believe that the study is much further advanced than is generally known and that a wind-tunnel program has been under way for several months.

Support Role

Both the Handley Page delta research aircraft due to fly shortly and the Short SC.5 will be expected to play a support role in the supersonic airliner development but neither is believed to have any direct association with the project. The SC.5 was originally built to confirm the low-speed handling characteristics of the English Electric Lightning, particularly with respect to the placing of the tailplane, an exercise which English Electric is believed to argue was entirely unnecessary.

This research aircraft has now been modified to fly with increased sweep and with a drooped leading edge developed by the Royal Aircraft Establishment.

Neither of these features is expected to be associated with development of the Lightning airframe and it seems most likely that they are more directly tied either to the TSR.2 or the supersonic transport.

Comments made by Sir George Edwards just before the placing of the contract now bear special significance. Speaking before the Institute of Directors, Sir George made a strong plea for the British and U.S. governments to get together and agree on the principle of cooperation and establish the cruising speed for the supersonic airliner at 1,500 mph.

Sir George suggested that due to the regrouping of the British aircraft industry the U.K. was in a more realistic position to appeal to the U.S. industry for a joint venture in this field.

Report Viewed as Basis For U.S. Transport

Washington—Supersonic jet transport survey conducted by United Research, Inc., for the Federal Aviation Agency is now viewed here as a first major step toward launching a supersonic transport program for the U.S.

Although the report (AW Oct. 31, p. 27) is generally optimistic in its conclusions on the feasibility of undertaking a program at this time, United Research has consolidated into its findings previous studies, some of which predict a limited market for the supersonic jet transport. For example, Lockheed Aircraft Corp. says it anticipates a world market for only 50 supersonic transports compared with the 200 United Research believes U.S. carriers alone will require between 1970 and 1975.

Thus the report is conceded by observers here to be a good cross-section of current thinking on the supersonic transport program and sound groundwork on which the White House can justify the economic practicality of the program. United Research found that the undertaking will require government support for 1970 completion.

The report stresses the financial risks which will be involved in the development and construction of a supersonic aircraft and points to the substantial losses manufacturers have sustained in the current round of commercial turbine equipment production. It estimates that Boeing has lost $165 million, Convair $221 million, Douglas $247 million and Lockheed $75 million for total loss of $708 million.

The report finds that the profit expectancy of a commercial supersonic transport program is relatively low when the long period of time funds will be tied up in the development program is taken into account. Assuming $4 billion in sales from 200 aircraft at $20 million per aircraft, net profit would amount to some $112 million, the report states. It said that to achieve this, it would be necessary to commit funds over a 12- to 13-year period.

The report notes that the Ford Motor Co. developed the Edsel with an outlay of $250 million but that Ford has 2.5 times the net worth of Boeing.

Douglas, General Dynamics, Lockheed and North American combined. Other financial risks which underscore the need for government support are:

• **Technical and market** risks are greater than for any previous commercial program.

• **Magnitude of fund** requirement for development program is too great and so difficult to estimate that a manufacturer could not adequately know the extent of the necessary commitment.

Central Route System Expanded by Board

Washington—Central Airlines won a broad expansion of its route system across a seven-state area last week in the Civil Aeronautics Board's Kansas-Oklahoma Local Service Case decision.

The Board's order, which also awarded new traffic stops for Ozark Air Lines and Trans-Texas Airways, carried a warning that local service awards must measure up to CAB's "use it or lose it" policy at an early date if the service is to be continued.

"By our awards in this case," the Board said, "we are making new or improved air services available to many communities at considerable cost to the government, in expectation that these services will be used by a sufficient number of persons to justify an outlay of government funds to support the services."

Extension of Central's route system gave the carrier the following new routes for an indefinite period:

• **Ft. Smith, Ark.**, to St. Louis, Mo., via Fayetteville and Harrison, Ark.

• **Kansas City, Mo.**, to Denver, Colo., via Topeka, Manhattan (Junction City), Ft. Riley, Salina, Hays, Goodland, Wichita, Hutchinson, Great Bend, Dodge City, Garden City, Kan., and Lamar, Pueblo, Colorado Springs, Colo.

• **Kansas City, Mo.**, to Oklahoma City and Tulsa, Okla., via Topeka, Independence (Coffeyville), Parsons, Kan., and Bartlesville, Okla.

Rearranging present Central route segments the Board authorized service between Amarillo, Tex., and the alternate terminal points of Wichita, Kan., Denver, Colo., and Oklahoma City and Tulsa, Okla., via Borger, Tex., Guymon, Okla., Liberal, Kan., Lamar, Pueblo and Colorado Springs, Colo., and Enid and Ponca City, Okla.

The airline also was granted a permanent extension of its Tulsa-Ft. Worth segment beyond Tulsa to Bartlesville, Okla., and the terminal point Wichita. In addition, Central's Tulsa-Oklahoma City segment also was extended to the intermediate points of Joplin, Springfield, and Ft. Leonard Wood, Mo., to the terminal point of St. Louis, Mo.

Flight Aid Development Progress Reported to RTCA Symposium

By Robert H. Cook

Washington—Progress reports on development of automatic landing and collision avoidance systems highlighted a two-day meeting here last week of the Radio Technical Commission for Aeronautics.

Technical reports singled out many unresolved issues which must be settled before final adoption of these electronic safety systems, but they agreed on these general conclusions:

• **Use of existing** and planned Instrument Landing Systems offers the most timely and practical means of implementing automatic landing capabilities.

• **Mutual exchange** of information between aircraft may prove to be the most accurate and reliable basis on which to develop a collision avoidance system.

• **Value of either** safety aid will depend upon its worldwide acceptance through the International Civil Aviation Organization.

G. B. Litchford of Airborne Instruments Laboratory emphasized the use of ILS systems as a logical transition link toward a fully automatic system in the future. Noting that the system selected will be required to serve a broad range of aircraft and geographical conditions, he emphasized that the international ILS system now used on about 400 runways will probably remain in use for at least another decade and could well be retained along with an automatic system. Most probable use for the ILS of the future would be for pilots requiring guidance down to the system's practical altitude limits of about 250 ft., he added.

Reluctance to Change

Litchford also cited the years of pilot experience which have been gained with ILS system landings, emphasizing that the "thousands of pilots who have been trained and have this experience are not likely to quickly adopt a new system. A new landing technique should be as compatible as possible with present ILS."

One of the major deficiencies in the use of ILS as a part of any fully automatic landing system, he pointed out, is the system's straight line guidance limitation, providing a vertical glide path so limited that it is difficult to follow below altitudes of 150 to 200 ft. Expected speed increases of future aircraft may require any finally adopted system to provide angle-above-glide-path information of as much as 20 deg., he said.

Litchford noted that extensive progress has been made on an airborne combination of a radar altimeter coupled to an ILS system, permitting the aircraft to descend on ILS to a point where the radar altimeter would be used for flare-out. However, he questioned the reliability of this system because of terrain variations which could make it difficult for a pilot to judge the final flare guidance before leaving the approach guidance. One of the more promising solutions envisions the use of a precision narrow scanning radio beam providing ILS type angle information from the runway to the aircraft over angles as high as 20 deg., he said.

Reviewing airline needs for an automatic landing system, Walter A. Jensen, of the Air Transport Assn., urged that any system finally adopted be economical and flexible for use at a wide variety of airports.

ATA Urges Flexibility

"We believe that the automatic landing system should make maximum use of existing equipment both on the ground and in aircraft," he said. "While we certainly are not opposed to transition to advanced techniques, it appears to us that existing equipments, particularly the glide path and localizer of the instrument landing system, are capable of considerable more than is now being made of them. We have encouraged the development of improved localizers and feel that more effort could be expended to achieve a similar improvement in the glide path." He added that any system selected should be capable of international standardization and implementation at a cost within the various countries' ability to pay.

C. R. Bryan, technical director of the flight control laboratory at Wright-Patterson AFB, reported that the laboratory has had good results with a letdown computer employing barometric altitude and Tacan or Vortac distance data to provide guidance information giving the vertical angle measured from an aiming point on the ground. The difference between the aircraft's glide path angle and the guidance angle to the ground, he said, is the basis for control action by the pilot, or autopilot, to follow the correct flight path.

The present automatic landing system program at Wright-Patterson shows the pilot not only the relationship of his aircraft and the ground but also what vertical control action is required and being taken automatically, he said. The procedure still allows the pilot to

Précision

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assume lateral control of the aircraft if he wishes, Bryan said.

Federal Aviation Agency progress in collision avoidance system testing was reviewed by James H. Muncy, who said that while self-contained units in aircraft would provide protection against a midair collision regardless of whether the oncoming aircraft was so equipped, this type of system can not meet the exacting angle and range measurements necessary to deliver a collision prediction. Time limits for an escape maneuver would require 25 to 30 sec. with accurate measurements at ranges from 10 to 20 mi. for jet operations, he said.

With a cooperative system, information such as altitude, speed and course can be exchanged between aircraft, simplifying the measurement problem. The system would detect oncoming aircraft, evaluate the collision threat and determine the proper escape maneuver to be executed by the pilot or the autopilot, he said.

FAA has a current contract with Bendix to test the feasibility of a cooperative CAS system exchanging altitude information and with range information obtained by ground-bouncing the signal carrying altitude information.

Work on the project to date has been "encouraging," Muncy said, with range and range rate data automatically extracted from the signals in flight and fed into a ground computer. Fully instrumented testing is scheduled for this month in a Bendix aircraft, and by December it will be delivered for testing in an FAA aircraft, he said.

"The approach to the collision avoidance system being followed by Bendix appeared to us as being the simplest to instrument," Muncy said. "More complicated systems have been proposed to us by others. Pending the outcome of the feasibility tests of the Bendix approach, we are not actively pursuing other collision avoidance systems."

Muncy said, however, that FAA has been investigating the antenna of a compatible proximity warning indicator/collision avoidance system proposed by the Sperry Gyroscope Company. This system is based on an exchange of altitude and velocity information between pairs of aircraft.

Summarizing the problems yet to be solved in developing a collision avoidance system, Frank C. White of ATA said that general agreement on a CAS cooperative system "is almost a dead issue. The evidence is piled waist-high in terms of several million dollars of private- and government-financed reports that a cooperative solution to CAS is a must at this time."

While suggestions for a CAS system have "run the gamut of the state of the electronic art," White said, any final choice must have worldwide acceptability to permit worldwide utility.

Northeast Awaits Release of 880; Plans to Begin Service on Dec. 15

By David H. Hoffman

Boston—Northeast Airlines is using Dec. 15 as its target date for inaugurating Convair 880 service along the eastern seaboard, but the financial stalemate between Howard Hughes and General Dynamics still remains a major stumbling block.

Under an agreement reached last spring, six jets will be drawn from the 30 Convair 880s ordered for Trans World Airlines by Hughes Tool Co. and, with Hughes' consent, leased to Northeast for seven years. Northeast said that terms of the lease, including an option to purchase, were hammered out with Convair and General Electric, manufacturer of the CJ-805 turbojets used on the 880.

"We have every expectation that 880s will be on the line by Dec. 15," James W. Austin, Northeast's president and general manager, told AVIATION WEEK last week. But at the same time Austin reported that Hughes, up to then, had refused to "release" any of the aircraft on order for TWA.

To finance Northeast's transition to jets, Hughes earlier had agreed to advance the carrier $9.5 million for working capital. Delivery of this sum could pose problems for Hughes, who still is negotiating a financing program for Trans World's jet order (AW Oct. 31, p. 35).

Meanwhile Northeast has been preparing its organization for arrival of the first aircraft with little advance warning, hoping that the 880s can be pressed into service during the peak Florida vacation season.

Defines Routes

Pending approval from the Civil Aeronautics Board, Northeast will not disclose which city pairs are scheduled to receive first 880 service. But the company has defined the new jet's routes, and these are known to include nonstop service between Boston and Montreal as well as Boston-New York-Miami schedules.

Introduction of the 880s will have no effect on Northeast's New York-to-Miami jet service, which is furnished with Boeing 707-300s leased from TWA, Austin said. Last week the carrier expanded these by adding a Saturday-only round trip with a 707 in 167-passenger, all-tourist configuration.

Maintenance workload at TWA permitting, Northeast will schedule a third Saturday jet trip to collect overflow passengers from the other two. Not a published schedule, this afternoon departure will be sold on a seven-day notice basis and leave Miami for New York Saturday evening.

To avoid delaying the start of service, Northeast is sending pilots and flight engineers to TWA's Kansas City, Mo., base for flight training, with the first 16 of 26 crews departing last week. If a TWA 880 is used, Northeast has agreed to pay $750 per block training hour, plus $45 for each instructor pilot hour and $30 for each flight engineer instructor hour. Should some training take place here in Northeast equipment, TWA's price is $809.13 per week per pilot instructor and $537.18 per flight engineer instructor.

Northeast Advertising

Although Northeast is expected to advertise "fastest to Miami" when it introduces 880 service from New York, the carrier reports that it will publish a southbound block-to-block time of 2 hr. 35 min. and a northbound time of 2 hr. 23 min., both based on Mach .84 cruise.

Operating Douglas DC-8s over the same route, National already lists some southbound schedules at 2 hr. 25 min. All National's northbound schedules are pegged at 2 hr. 25 min. as are those of Eastern and the Northeast 707, even though the 707 and the DC-8 usually use a slower Mach .82 figure in establishing cruise power.

MATS Evaluates Bids For 1961 Contracts

Washington—Military Air Transport Service expects to announce awards for the bulk of its 1961 passenger contract business in "two to three weeks."

Twenty-one airlines were invited to submit proposals by a Nov. 7 deadline for flying about 220,000 military passengers to and from overseas stations during the next calendar year.

The minimum rate MATS will consider is 2.9 cents a passenger mile. Air Force reluctantly accepted this floor rate at the insistence of Civil Aeronautics Board, and put it into effect for the first time in awarding contracts for passenger traffic for the October-December period of this year (AW Sept. 12, p. 41).

In making the last quarter awards, MATS noted it "will consider not only the price but also the ability of the airlines to expand their operations for MATS' use in emergency and the value to MATS of the types of aircraft offered."

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CL-44 Loading Aims for 1 hr. Turn-Around

By Erwin J. Bulban

Tulsa, Okla.—Mechanized loading system for the Canadair CL-44 turboprop cargo transport is designed to ensure a turn-around of one hour from the time that the airplane taxies into the loading area until it taxies out again, with actual unloading and loading of a complete payload taking 45 min.

The new airplane, ordered by Flying Tiger Line, Seaboard & Western Airlines and Slick Airways, has a maximum payload of 63,000 lb. and over 3,000 stat. mi. still-air range in domestic operations. Direct operating costs are approximately 4 cents per ton statute mile on domestic transcontinental stage lengths.

Key to quick turn-around time of the CL-44 is the high degree of mechanization developed in cargo loading, an approach that was attacked after careful analysis indicated that conventional loading methods would require five hours to handle the payloads envisaged, according to Canadair's chief engineer E. H. Higgins.

Once the one-hour goal had been established, he notes, significant penalties in the form of weight, cube loss, complexity and cost were unacceptable to reduce the theoretical turn-around time below this target.

With a net usable volume of 5,900 cu. ft. inside pallet and container envelopes and including true usable volume of the piece loading areas in the swing-tail and opposite the forward cargo door, the CL-44 achieves full weight limited payload with an average warehouse density of 12.8 lb./cu. ft., based on stacking efficiencies of 85% for pallets and containers and 75% for the piece-loaded compartments.

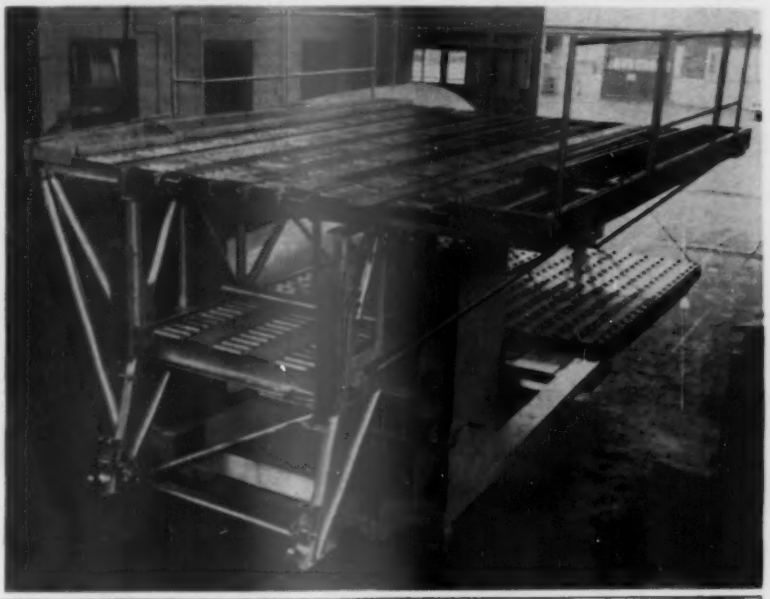
Initial studies of loading systems followed the general pattern of a rigid pallet riding on a roller bed in the aircraft floor. It was ascertained that this system involved a weight penalty of 10% of the main compartment payload and a cube loss of more than 300 cu. ft. due to depth of rollers and pallet alone.

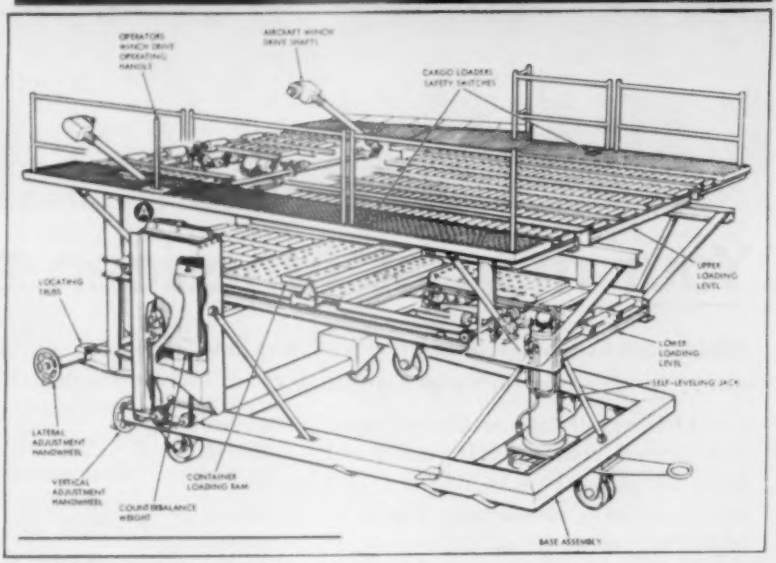
This resulted in a new approach based on a lightweight flexible pallet, riding on rubbing strips instead of rollers and pulled into or out of the main compartment by a chain drive on each side of the floor. Feasibility of this system has been demonstrated in a full-scale functional test rig and is in production for CL-44 customers.

Flexible pallet is of metal faced plywood construction approximately ¾-in. thick with aluminum alloy rubbing strips bonded to the bottom surface. These strips ride on matching strips, on the aircraft floor, which are made from extruded nylon impregnated with a dry lubricant. Side edges of the pallet have net attachment fittings and guide rollers which engage overlapping guide rails along each side of the aircraft floor.

The pallet, with a load capacity of 8,000 lb., weighs only 140 lb. and the Dacron throw-over net only 18 lb., estimated to be approximately half the weight of a rigid pallet design. Negative-g flight loads and design side loads are transmitted from the throw-over net to the side rails and tests have been completed which show that deflections under both conditions will not foul the aircraft structure, Higgins reported.

Barrier nets, designed to take 9g forward crash loads, are attached to longitudinal straps along the fuselage sides and to the six tie-down rails in the aircraft floor. Barrier nets weigh less than 20 lb. each, are interchangeable and





PROTOTYPE "level loader" platform developed by Canadair is designed for attachment to main cargo compartment sill when tail is swung aside to permit feeding cargo on pallets directly into the fuselage. Lower platform, fitted with rollers, allows cargo loading into the aft underbelly compartment, using a container loading ram. Level platform, which automatically compensates for fuselage movement, attaches to aircraft at end nearest camera.

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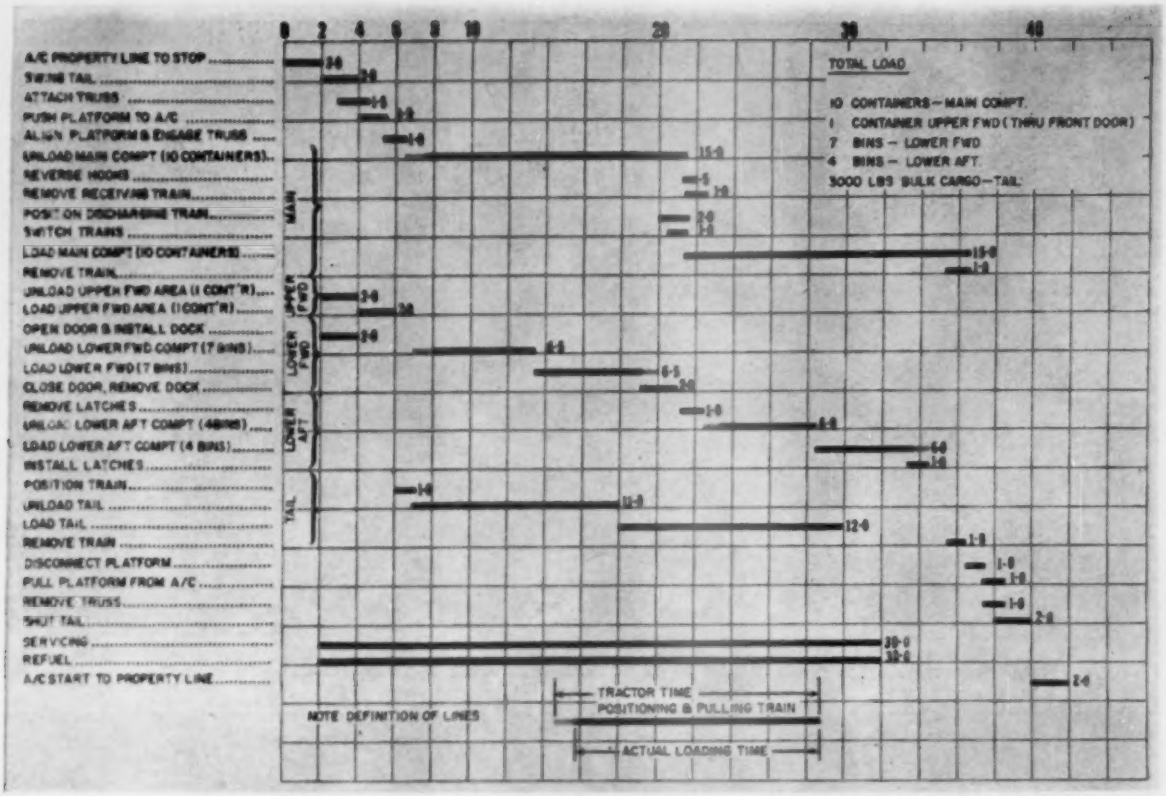


TIME-MOTION analysis of CL-44 loading and aircraft servicing and fueling shows turnaround of less than 45 min. estimated as result of integrated cargo handling system developed by the company for the turboprop cargo transport.

can be attached or detached in less than 45 sec. They are normally carried on the back face of each pallet load.

Winching system for transferring palletized loads along the main compartment floor consists of a chain drive on each side of the floor within the pallet guide rails. A spring-loaded hook attached to the drive chain runs in the lower channel and this hook engages fittings on each side of the pallet. Tests in Canadair's functional rig have shown that loads can be pulled or pushed by the chain system and the load can easily be transferred when driven by the chain on only one side.

Remaining essential for the Canadair-designed system, which is entering the full-scale functional test stage, is the transfer platform. Front end of the platform attaches to the airplane at the loading sill and is designed to follow deflections of the sill in all directions—up and down, sideways and rotational. A simple level switch senses movement and energizes a jack at the rear point of support to move it in a direction that will hold the platform level as the fuselage moves up and down.

A standard fork lift of approximately 15,000 lb. capacity is the only other piece of equipment required to complete the CL-44 system, according to Higgins. The pallet train can be brought to the airplane on dollies; the fork lift is fitted with a roller bed which may be inserted under the dolly beds, which are of "egg-crate" design. When the roller platform is raised, the pallet rests on the rollers and when lifted into position at the back of the transfer platform, the fork lift bed may be tilted forward until the pallet rolls onto the platform.

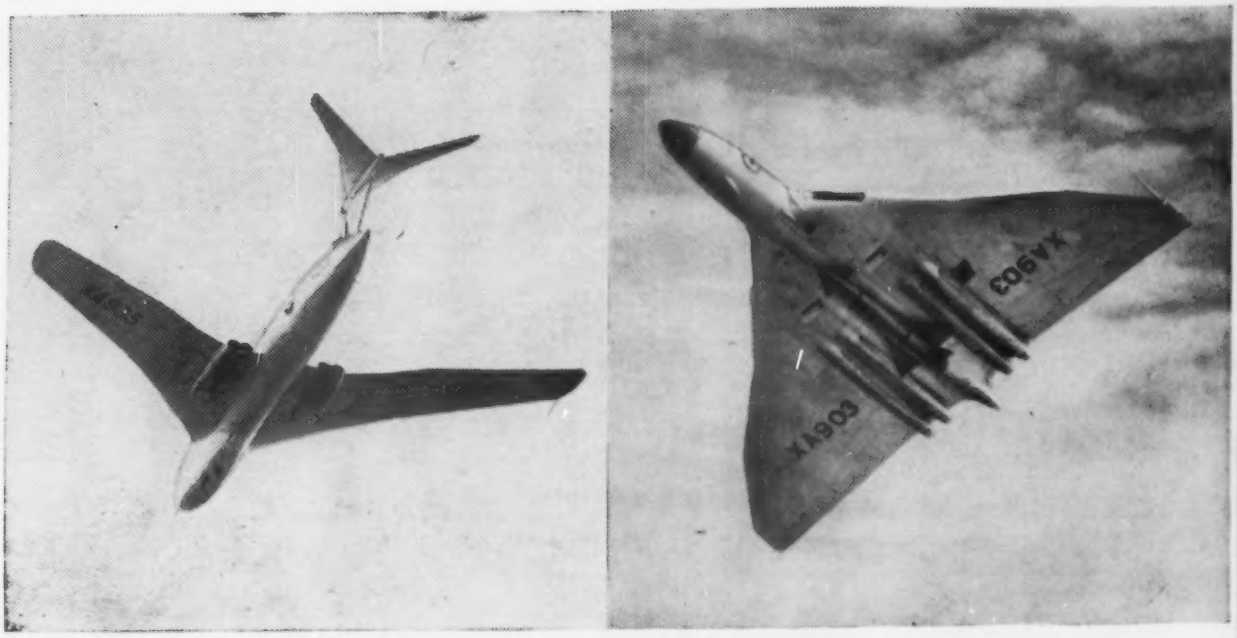
The transfer platform is designed so that it can be carried in the airplane to permit operations at unprepared bases.

Although versions of the transfer platform will be powered, the basic design concept is to ensure that the entire system can be operated using a standard fork lift as the only essential piece of additional equipment. For this reason, sockets are provided at the aft end of the platform base to permit using the fork lift to move the platform into position at the sill of the airplane.

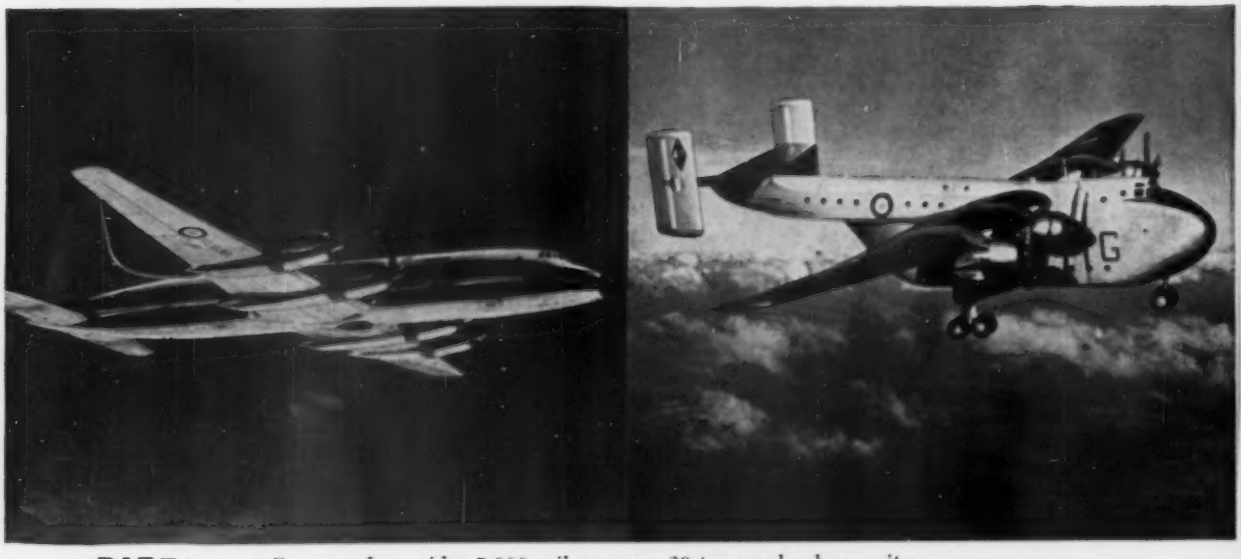
Tests have demonstrated that an 8,000-lb. load can be easily moved along the transfer platform by one man on each side, including the case where the one load is initially placed on the platform off-center and cocked to one side. Guide rollers near the four corners of the pallet follow the guide rails on each side of the platform, acting as a funnel to bring the pallet into correct alignment within the guide rails in the airplane.

Considerable test work has been done on determining characteristics of the material to be used in the rubbing strips. Three materials tested in combination with the aluminum alloy strips on the pallet were nylon, Teflon and nylon impregnated with molybdenum disulphate. The latter material proved most efficient, Higgins noted, having an initial coefficient of friction of 0.15. Test program included 10,000 cycles of loading and unloading, during which sharp silicon sand was applied to the rubbing surfaces on the average of every 150 cycles. At the end of this program, the coefficient of friction had risen slightly to 0.17. Total wear on the plastic rub strips was less than 10% of the original thickness and approximately 35% wear was found along the edges of the worst aluminum strips on the bottom of the pallet, Higgins stated. No repairs or replacements were required during or at the end of this program, he added.

Modifications to the winching system were found necessary early in the test program to provide better tension control under load, but no replacements or repairs were necessary during the final 9,000 cycles of operation, he said.



RAF deterrent force relies on the most advanced aircraft and missiles...



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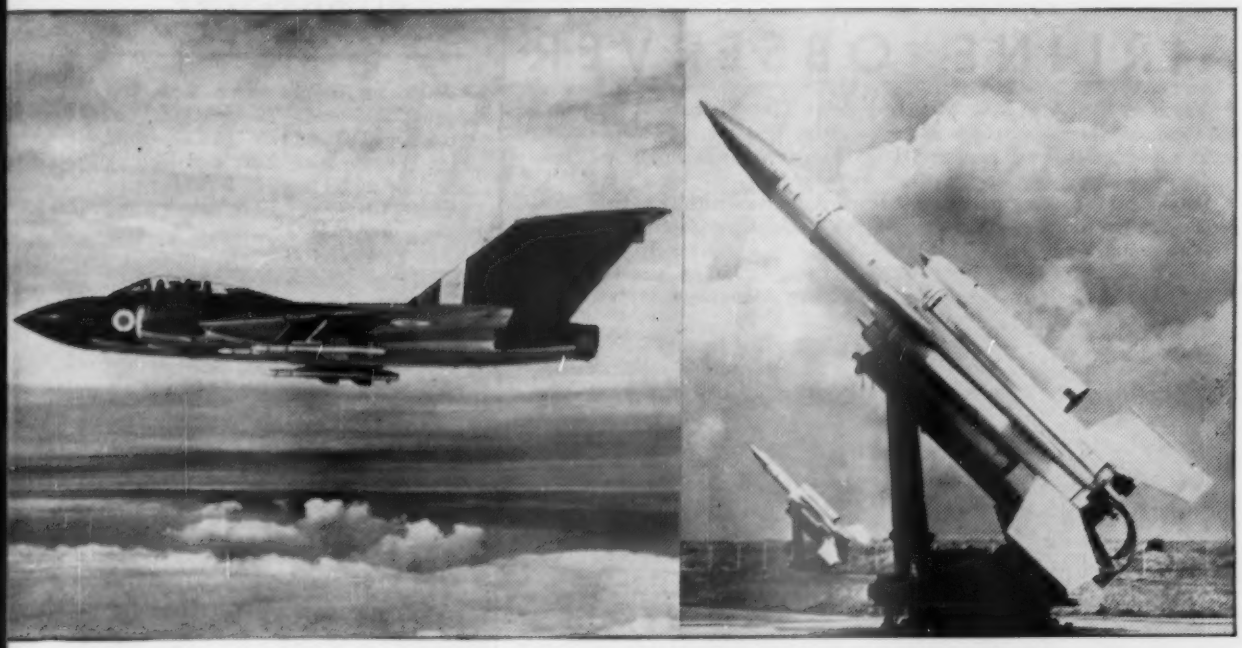
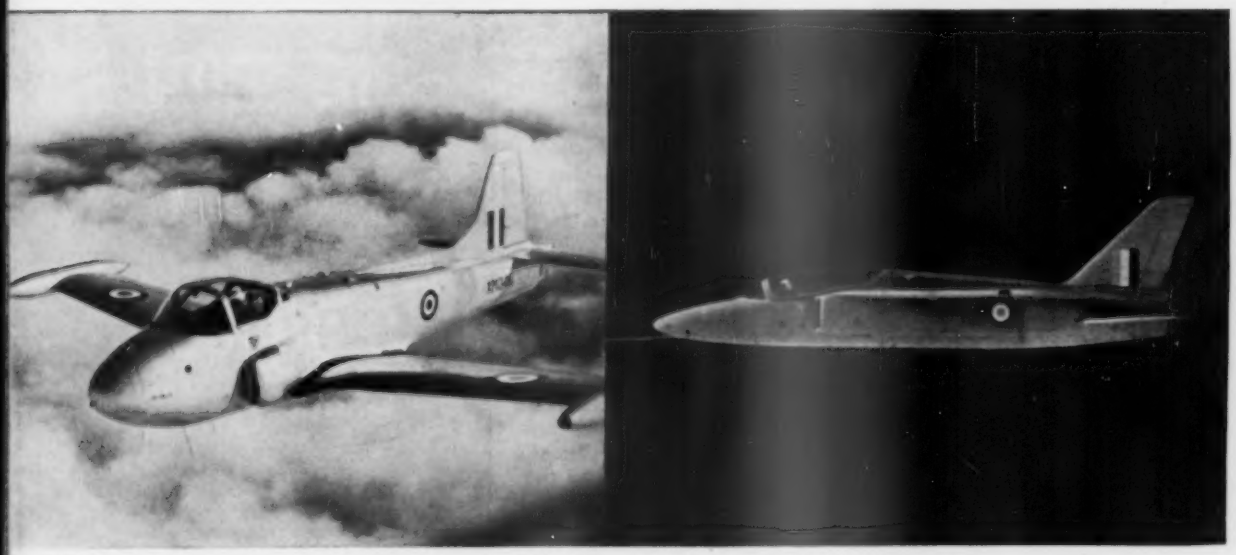


RAF round-the-clock defence intercepts aircraft hundreds of miles out, far up into the stratosphere . . .



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AIRLINE OBSERVER

▶ Watch for Sen. A. S. Mike Monroney to press for extension of the federal aid-to-airports program, which is due to expire next year. Sen. Monroney seeks a program that will provide $100 million annually in airport aid funds.

▶ Aeroflot plans to inaugurate its first scheduled service with new, twin-turbojet Tu-124 transports on the Moscow-Perm and Moscow-Chelyabinsk routes. The two routes are about 725 and 925 mi. long respectively. Late last month, a 24-passenger version of the Tu-124 made a 750 mi. test flight from Moscow to Krasnodar, north of the Caucasus Mountains, in two hours. Top speed was about 621 mph.

▶ Chances are now strong that the Spanish government will authorize Iberia Air Lines to buy a fleet of four Caravelle turboprop transports.

▶ Air traffic holding delays up to one hour at Orly Airport, Paris, have resulted from a slowdown by dissatisfied air traffic control personnel. Controllers, who are seeking higher pay through job reclassification, struck twice last month for short periods of time, but returned to work when the government threatened to draft them. Slowdown is conducted through a strict application of minimum separation rules for aircraft entering Orly traffic control region. Ground delays are caused by withholding clearances from ramp to runway for takeoff for as long as 20 min.

▶ Lockheed Aircraft Corp. now expects to finish its flight and static test program on the Electra turboprop transport (AW Oct. 24, p. 37) by Dec. 1.

▶ International Brotherhood of Teamsters lost its first strong bid to represent airline mechanics when National Airlines' mechanics rejected a formal Teamster bid by a vote of 715 to 402. Outcome of the systemwide union representation election came as a distinct upset to Teamster officials, who point out that more than half the airline's International Assn. of Machinist members had petitioned the National Mediation Board to conduct the election.

▶ Aeroflot has signed its first pooling agreement with a Western carrier—British European Airways. Agreement, signed in Moscow, provides for pooling of all revenues earned by the two carriers on the London-Moscow route and splitting of proceeds on a 50-50 basis.

▶ Air France has been flying a Boeing 707 turbojet transport on occasional New York-Mexico City schedules as substitute equipment, although the bilateral agreement between France and Mexico limits flights of the French carrier to four piston-engine aircraft flights weekly. Because Air France transatlantic flights are now served by jet equipment, the carrier must maintain piston-engine equipment in the U. S. for the New York-Mexico City segment of its route. Boeings are pressed into service when piston-engine equipment is unavailable. Chances are now strong that the bilateral, which is currently being renegotiated, will permit jet flights on the route by the first of the year.

▶ Douglas Aircraft Co. now has contracts to convert a total of 16 DC-7C transports to all-cargo configuration. Carriers involved are Alitalia, British Overseas Airways, Japan Air Lines and Riddle Air Lines. Conversion costs average $320,000 per airplane.

▶ Cuba has banned all flying within a cordon of airspace extending 30 mi. into the Caribbean from the north coast of Pinar del Rio province, which covers the island's western tip but does not include Havana. The attempt to prohibit air activity in international airspace coincided with a U. S. disclosure that Cuba's Castro government is importing and stockpiling arms from Communist bloc countries. Operations of U. S. airlines have not been affected by the ban.

▶ American Airlines, in a move to restore public confidence in the Lockheed Electra, is conducting a series of press conferences in 19 key cities on its system now served by Electras. Series of accidents, reasons for speed restrictions and current modification program are openly discussed during the conferences by officials of the airline in attempts to dispel any elements of mystery surrounding the Electra problems (AW Oct. 24, p. 37).

SHORTLINES

▶ **American Airlines** added these new Boeing 707 and 720 schedules last week: One 707 and two 720 daily round trips between New York and Detroit; one daily round trip 720 flight between Detroit, Chicago and Los Angeles; two daily round trip 720 flights between New York and Toronto; two daily round trip 707 flights between New York and St. Louis; one daily 707 round trip flight between Los Angeles and Phoenix. A second round trip 707 schedule has been added between Boston and Chicago.

▶ **British Overseas Airways Corp.**, flew 94,817 passengers on its international routes in July. The carrier flew a total of 306,394,000 passenger miles and maintained a passenger load factor of 67.0%. British European Airways carried 509,435 passengers over its international routes, flew 175,479,000 passenger miles and had a load factor of 72.2% in the same period.

▶ **Continental Airlines** reports a net income of $1,247,000 for the first nine months of 1960, which the carrier says is almost triple its income during the same period in 1959. The airline said it had carried 1,018,000 passengers by the end of the third quarter. Continental's third quarter net income was $732,000, a 24% increase over the profit in the same 1959 period.

▶ **Flying Tiger Line** reports a net loss of $566,460 for the third quarter of 1960. The carrier attributed the loss to cutbacks in military contract operations and a decline in airfreight revenues during the period.

▶ **Lineas Aeros de Nicaragua, S. A.**, has been awarded a foreign air carrier permit by the Civil Aeronautics Board. The airline will operate from Managua, Nicaragua to San Salvador, El Salvador and Miami. Off-route charter operations will be permitted.

▶ **Pan American World Airways** says it will offer freight capacity of 500,000-lb. on its transpacific routes beginning this month. The international airline is now operating converted Douglas DC-7F all-cargo aircraft on its Pacific routes.

▶ **Southern Airways** has been granted authority by Civil Aeronautics Board to extend trade agreements with advertisers providing for air travel in exchange for advertising. The local service airline asked for extensions to compensate for the period when labor troubles made the reciprocal services of the airline unavailable to advertising agencies.

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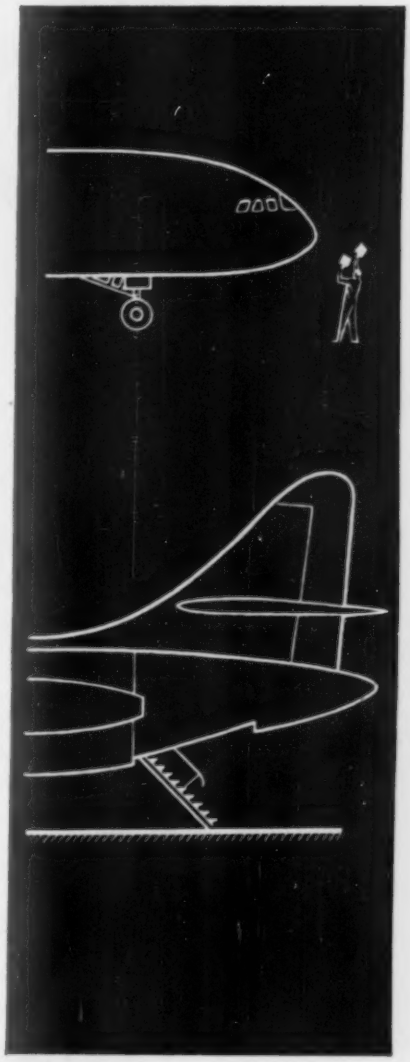

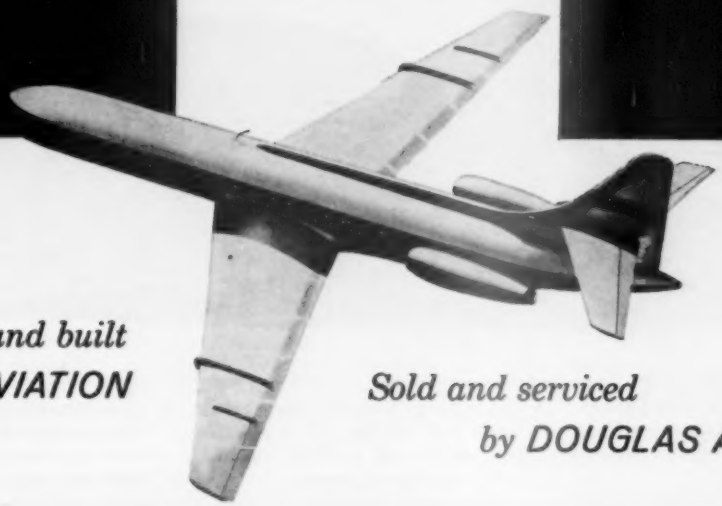

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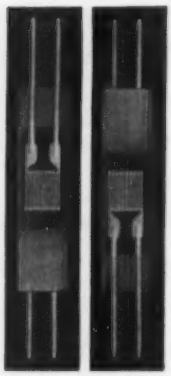

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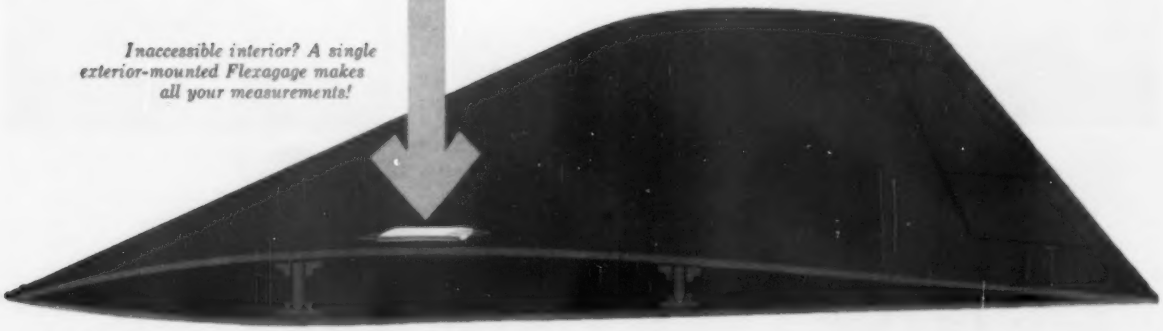

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Transit IIIA Planned for Nov. 29 Launch

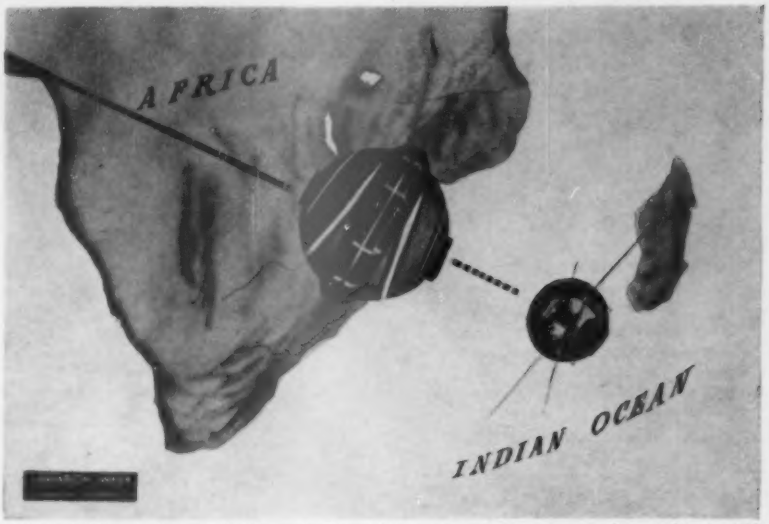
Washington—Transit IIIA, 300-lb., multiple-payload, navigation-aid satellite with at least two new experiments, is programed to be fired into a 500-naut. mi.-altitude circular orbit between 11:30 p.m. and 3:30 a.m. EST on Nov. 29-30 from Cape Canaveral, Fla.

A new trajectory—southeast across the Atlantic—will be programed for this fourth launch in a series of doppler technique experiments projected to evolve into an operational space navigation-aid system for use by surface vessels and submarines, sometime in 1962. Transit series satellites also are intended to establish feasibility of an aircraft doppler navigation system.

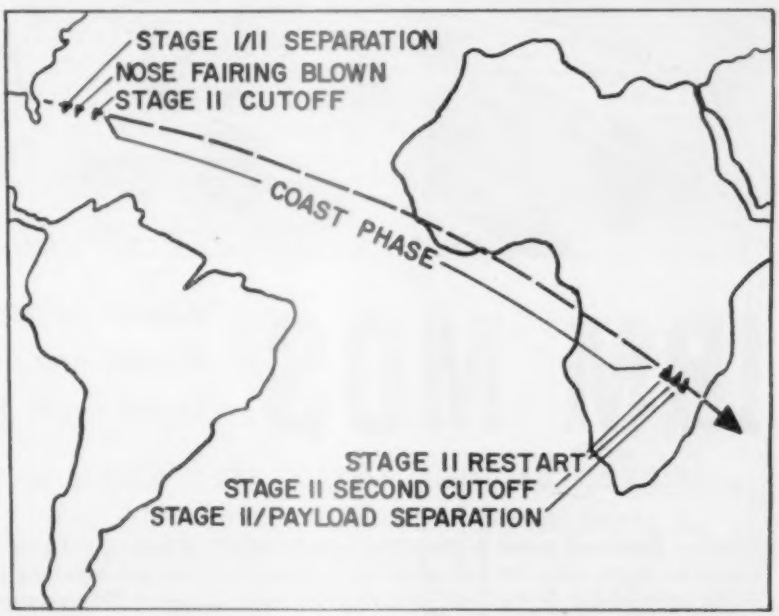
Multiple payloads for the Transit IIIA satellite will include:

• **LOFTI (Low Frequency Trans-Ionosphere)** experiment, a special Naval Research Laboratory payload housed in a 20-in.-dia. shell carried piggyback on the basic navigation-aid payload. Configuration of this piggyback payload is identical with that which housed the "bonus" Lyman-Alpha and X-ray radiation experiments in Transit IIA (AW June 20, p. 76). LOFTI experiment, projected to establish feasibility of transmitting very low frequency radio signals from the ground through the ionosphere for reception by an earth satellite, will measure attenuation of an 18-kc. signal.

• **Basic navigation-aid,** 36-in.-dia. payload, developed by Johns Hopkins Applied Physics Laboratory, is the same fundamental configuration that was used in Transit IIA experiment but, for the first time, will contain a new piece of development equipment to demonstrate the performance of an injection memory system (digital computer) carried in the satellite.



TWO satellites in Transit IIIA navigation-aid experiment are programed to orbit in 500-naut. mi.-altitude circular path after separating from Able Star vehicle over Mozambique.



TRANSIT IIIA southeast path to injection into orbit is third specific trajectory to be flown in ARPA-Navy-APL navigation experiment program.

Digital Data Injection

A ground station will inject (transmit) orbital values and other associated digital data to the satellite for storage and subsequent readout—probably at one-minute intervals. In effect, any vessel at sea which measures the doppler shift of the satellite's signal and receives the orbital trajectory information will be able to plot its position. Transmission of the digital information from the ground to the satellite and back to ground will be modulated by a radio-frequency carrier.

Associated equipment includes coding devices and timing and control equipment.

SECOR (Sequential Collation of Range) experiment also has been scheduled for incorporation in the APL basic payload, but indications are that Navy and APL payload managers are considering eliminating this equipment from the satellite.

Basically, SECOR is a transponder to gather geodetic data, for transmission to ground stations on a frequency (448 mc.) different from those used for transmission of information from other APL payload experiments.

Refractive index correction-experiment, also carried in previous Transit satellites, is projected to confirm theoretical mathematical relationship be-

Mr. S. E. Miller, Vice President and Division Manager of American Bosch Arma, shows the hundreds of items which go into the manufacture of a fuel injection pump (upper left of table).

IBM MOS

MANAGEMENT OPERATING SYSTEM SAVES AMERICAN BOSCH $120,000 YEARLY ON SHOP ORDERS ALONE

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American Bosch has turned to IBM's new systems techniques for faster, more sensitive control of its manufacturing cycle at the Springfield, Massachusetts, plant. Utilizing the IBM Ramac 305, the Management Operating System has been applied to Materials Planning and Inventory Management, and large savings have already accrued.

These additional savings are expected from methods now in use:

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Transit IIIA Aims

Navigation-aid experiment in the Advanced Research Projects Agency-Navy-Applied Physics Laboratory program will have these general objectives:

- **Development of a shipboard navigation system.**
- **Establish feasibility of an aircraft-doppler navigation system.**
- **Test the performance of an injection memory system operating in a satellite.**
- **Geodetic analysis, to determine, with very high accuracy, the figure of the earth.**
- **Demonstrate relationship between ionosphere's refractive index and transmission frequency.**
- **Special experiment to study low frequency trans-ionosphere characteristics to measure attenuation of radio signal from ground to satellite.**

tween frequency and the ionosphere's refractive index. This payload equipment will transmit four continuous-wave signals to a group of ground stations manned by APL personnel.

Another experiment will gather information for a geodetic analysis to determine, with very high accuracy, the shape of the earth. This study will analyze orbital predictions and earth's gravitational field for more precise relation.

One Applied Physics Laboratory tracking team using a mobile ground station will conduct a navigation demonstration after accumulation of sufficient tracking data from other ground facilities.

Launch Data

The Thor-Able Star launch vehicle will be fired vertically, then given a heading downrange of approximately 110 deg. Trajectory will take the relevant stages of the vehicle across the Atlantic, then over Africa's Sierra Leone, Liberia, Gulf of Guinea, Angola, Federation of Rhodesia and Nyasaland, and Mozambique, where payload separation will occur.

Air Force's Douglas Thor booster will incorporate a programed flight controller and telemetry for data on various boost phase functions.

Shortly after liftoff, the vehicle will be rotated on its longitudinal axis to achieve a programed heading to start a pitch maneuver, which will put the vehicle into a gravity turn along the planned trajectory.

Trajectory sequences will include these highlights:

- **Cutoff of Thor booster** occurs about 160 sec. after liftoff.
- **Blowing of explosive bolts** about 4 to 5 sec. after Thor engine is cut off, will separate the Aerojet-General 7,750-lb.-thrust Able Star second stage, with its propulsion system already burning.

The Able Star vehicle will incorporate Space Technology Laboratories' advanced guidance system which will be keyed with the ground-based Burroughs J-1 computer at Cape Canaveral. Space Electronics Corp. is providing and installing avionic equipment for the Able Star stage beginning with the Transit IIIA in the experiments.

- **Nose fairing** on the Able Star vehicle will be jettisoned at about 223 sec. after liftoff.
- **Able Star engine shutdown** by radio command signal from ground will be at about 460 sec. after liftoff.
- **Coast phase then begins,** continues for approximately 30 min., with control about the three axes performed by a pneumatic system.
- **Able Star engine restarts** at end of coast phase, burns for only about five seconds, vehicle is spun to attain a rotation of 50 to 60 rpm., and entire vehicle is injected into orbit, which will be considered successful if the apogee roughly does not exceed about 600 naut. mi. and the perigee is not less than approximately 400 naut. mi. Orbital inclination is expected to be about 29 deg.
- **Explosive bolts** holding payload to Able Star will be blown at about 2 sec. after Able Star engine's second shutdown, basic payload will separate from the Able Star vehicle and the piggyback payload will separate from the basic payload.
- **Spin-down** to about 0.3 rpm. will occur within the first 25 days in orbit.

Basic navigation-aid payload for Transit IIIA will have the same construction which was used for previous Transit experiments.

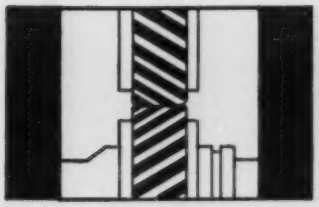
Fiberglas face sheets will be used over ½-in. nylon-phenolic honeycomb core. A vertical Fiberglas tube will stiffen the payload structure against launch forces.

Power Supply

The solar cell installation around the payload's equator will charge nickel-cadmium batteries to supply power for the payload's command receivers, two sets of stable, continuous-wave doppler transmitters (108, 162, 216 and 324 mc.), FM/PM telemetry transmitters, oscillators, the memory system, radio frequency amplifiers and multipliers, very low frequency radio receiver, and various sensors for payload environment.

The LOFTI piggyback payload will have its own solar cell installation.

Prelaunch tests at Cape Canaveral will include calibration checks of the ground-based equipment which will complement the airborne advanced guidance system in the Able Star vehicle. Aircraft will be used in this



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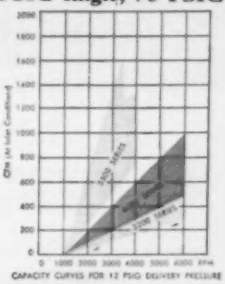

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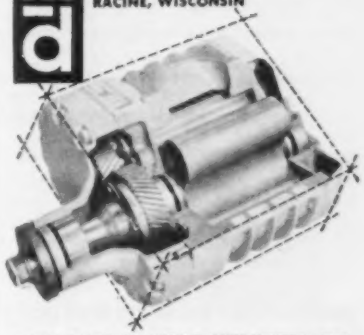

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TYPICAL SPECIFICATIONS

Trimmed Drift Rate: 0.01 degrees/hr

Angular Momentum: 300,000 c.g.s. units

Damping: 300,000 c.g.s. units

Nominal Signal Generator Sensitivity: 10 mv/mr @ 50 ma, 400 cps

Torque Generator Sensitivity Range: 0.05 to 3.0 degrees/hr/ma^2

Time Constant: As low as 0.4 msec.

Mass Unbalance: 0.4°/hr/g

Anisoelasticity: 0.003°/hr/g^2

Dimensions: 1.8 in. x 2.75 in.

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checkout procedure. Another prelaunch check will involve all instrumentation and equipment in the missile, including real-time communication capability.

Tracking capability for the Transit IIIA experiment will involve these facilities:

- **Applied Physics Laboratory,** at its main station in Maryland, will be the ultimate reception center for all information transmitted by Transit IIIA basic navigation-aid payload. Doppler signals will be received by seven APL ground installations.
- **Navy Research Laboratory** will analyze all data forwarded to it from stations receiving information from the LOFTI piggyback satellite, via Cape Canaveral as a central gathering point.
- **AFBMD/STL Space Navigation Center** (SPAN) facilities at Cape Canaveral will receive telemetry data from midcourse, downrange and injection phases of the trajectory as well as initial orbital data, and forward this to APL.
- **Air Force Cambridge Research Center** will be furnished with injection data by span, will perform tracking during the initial orbits of Transit IIIA and supply orbital prediction information to other participants in the tracking effort.
- **STL mobile van** will be stationed in Africa for telemetry reception from the Able Star vehicle for the downrange and injection portions of the trajectory.
- **Initial orbital pass** of Transit IIIA will be tracked by facilities at Hawaii's South Point Station, White Sands, N. M., Millstone Hill, Mass., Pacific Missile Range's Pt. Arguello site, and Australia's Woomera station.

Real Time System To Be Installed at PMR

San Diego—A real time computation system which will provide a means for controlled rendezvous of two space vehicles orbiting the earth will be installed by Convair Division, General Dynamics Corp., at Pacific Missile Range under a Navy contract awarded last week.

The system will integrate tracking, prediction and control tasks required for missile and space vehicle operations at the missile range. Real time capability of the system will permit measurements of vehicle position to be accepted every tenth of a second from as many as six radars.

Calculations for impact prediction, range safety, and vehicle control will be performed between measurements, so that a progressive record of computed data is provided every tenth of a second.

Electronics Associates, Inc., Long Branch, N. J., has subcontracted with Convair for a portion of the high-speed computing equipment required.

PIONEERING IS OUR BUSINESS

NEWS about advanced Bendix® research in space environment systems

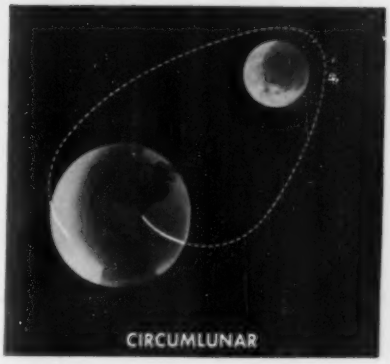
Providing an environment in which man can continue to exist, live, and breathe, as required for each new generation of space vehicles, is well on the way to accomplishment at Pioneer-Central. This brief look at what we are doing to help solve key space environment problems reflects only one phase of our total pioneering research activities.

FIRST GENERATION:

This closed atmosphere Bendix system will supply a man with breathing oxygen, dispose of his respired carbon dioxide, and completely ventilate and condition his environment. Soon to be ready for check-out by Air Force team on high-altitude jet aircraft prior to ultimate use on manned space vehicles.

SECOND GENERATION:

Here a Bendix individual space environment system is also nearing completion. It is self-powered and controlled by man's metabolic processes. Oxygen is supplied by either super-oxides or a zero "G" liquid gas converter—both of which are now being developed by Pioneer-Central.



THIRD GENERATION:

Involved here is the use of algae for atmosphere control in a closed ecology system. Algae can maintain a compatible atmosphere for long periods, can be applied to orbital and lunar research stations, and are applicable to converting man's waste products into man's body necessities. Our system—now in the development stage—will convert the respiratory waste products into reusable breathing oxygen.

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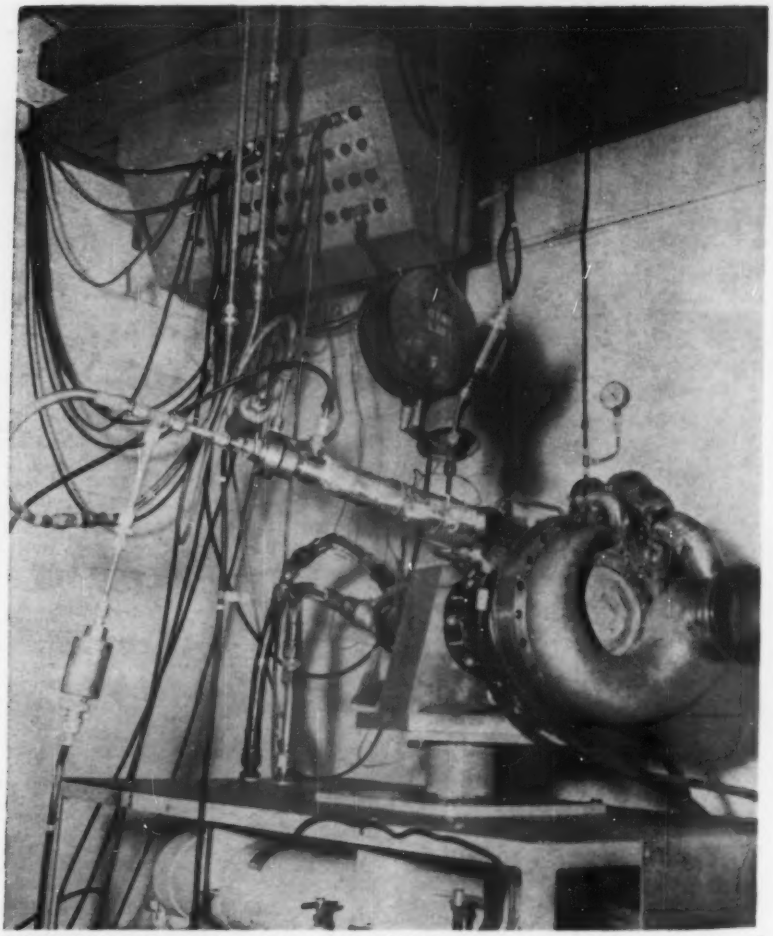
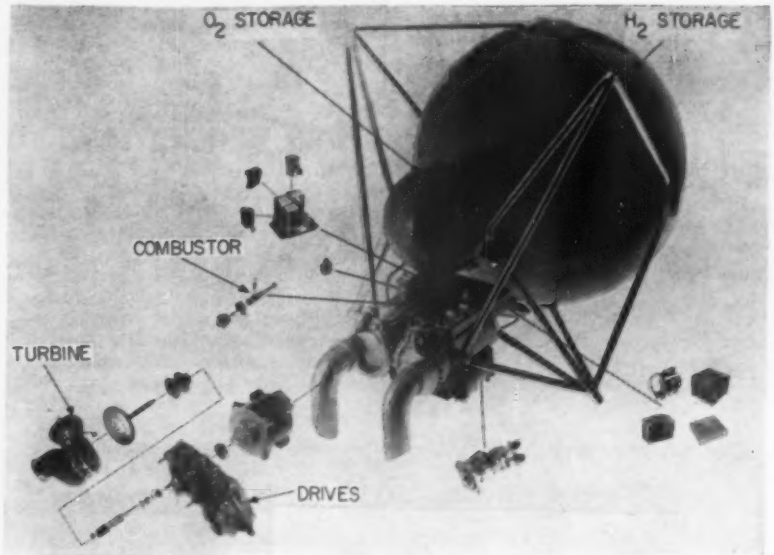


AIRESEARCH power supply turbine turns at 45,000 rpm., operates on the combustion of hydrogen and oxygen. Note foil-covered combustor with spark plug.



EXPLODED view of the AiResearch power supply and heat sink components of an integrated power and environmental control system is shown above.

By William S. Reed

Los Angeles—An integrated power supply and environmental control system for a Project Apollo-type, three-man, two-week, earth orbiting capsule has been formulated by the Garrett Corp.'s AiResearch Division under a company-funded program.

Results of AiResearch's analysis had been submitted to the Martin Co., General Dynamics Corp.'s Convair Division, and General Electric Co., the three industry members selected by the National Aeronautics and Space Administration to conduct Apollo study contracts projected to lead to award of a prime contract for the space capsule in about one year. AiResearch's study also had been made available to the eleven other unsuccessful proposers in the Apollo competition.

AiResearch's approach is based on the concept that economy of weight and efficient use of fuel—critical parameters for space application—demands that the power supply system, the environmental control system and probably the attitude control system should be combined into an integrated design, consisting of the following basic elements using hydrogen and oxygen for fuel:

• **Fuel tankage.** The hydrogen and oxygen are stored in a gaseous but very cold state just above liquefying temperature. This super-critical storage eliminates the problems attendant with liquid storage and gas expulsion in a weightless state. Amount of fuel needed to produce three kilowatts of continuous power is 170 lb. of hydrogen and 65 lb. of oxygen.

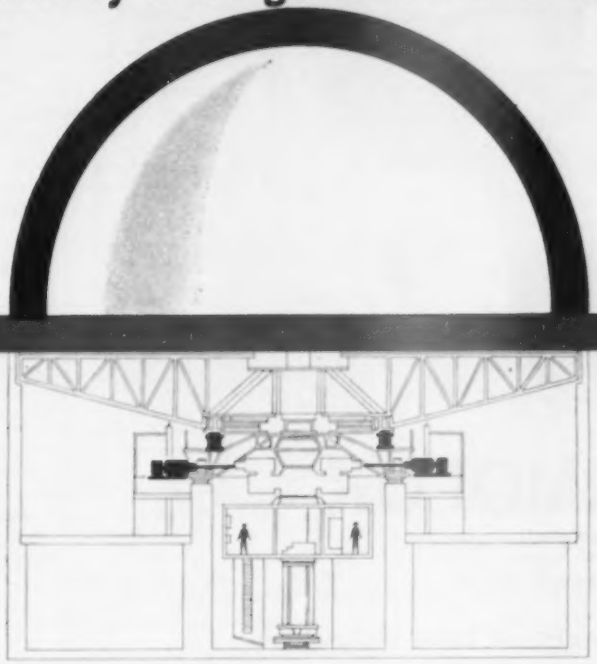
• **Heat exchanger.** Supercritical hydrogen is passed through a heat exchanger as a heat sink to absorb the 1,800 Btu./hr. generated by the crew and the electrical and electronic components. Sufficient extra hydrogen is provided to allow for dissipation of a total heat build-up of 100,000 Btu. during re-entry.

• **Combustor.** AiResearch has a laboratory model of a hydrogen-oxygen combustor which exhausts into a turbine turning at 48,000 rpm., shrouded by a double re-entry scroll. Practically no product other than a slight amount of water results from the combustion process.

• **Drives.** Alternators, generators or hydraulic pumps can be driven from the turbine.

• **Exhaust.** Attitude control can be powered from the exhaust of the combustor sufficient to provide the .25 lb. thrust necessary for maintaining a stable platform once in orbit. Attitude positioning immediately after separation,

Radar Antenna Drive by Westinghouse for Nike-Zeus* on Kwajalein



On some undisclosed date in the future, the free world's only anti-ICBM missile system now in development—the U. S. Army's Nike-Zeus—will face another critical test.

A Nike-Zeus complex located on tiny Kwajalein Atoll in the Pacific must detect, track and kill oncoming ICBM's. USAF crews will fire the would-be enemy (Atlas) missiles from Vandenberg AFB.

One of the key performers in the spectacular intercept will be 1250 tons of Acquisition Radar standing several stories high. Westinghouse is supplying the antenna drive motors and controls and a 30′ dia. hydrodynamic thrust bearing under subcontract to Goodyear Aircraft Corp. Westinghouse is one of the few companies, anywhere, that could manufacture a bearing of this size.

Imagine the demand for precision accuracy and delicate maneuvering to get the jump on an ICBM. Tolerances for the bearing were extremely exacting: sectors of the 30′ diameter segmented bearing must be held flat within .0005″.

Westinghouse can supply complete drive systems and mechanical components for just about any type of radar antenna. From a simple AC drive for continuous scanning on up to complex solar exploration radar. We provide the complete package: motors, gearing, controls, thrust bearings, etc.

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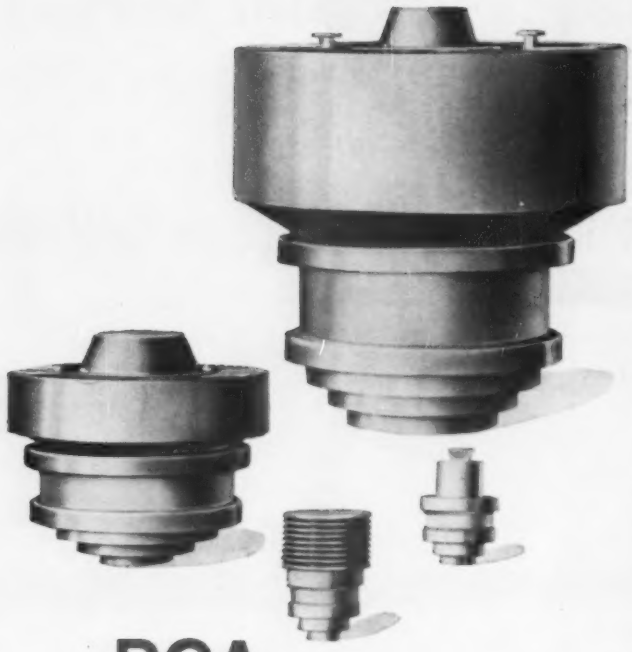
*Prime Contractor: Western Electric Co./Bell Telephone Laboratories.

Westinghouse



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a new concept in Beam Power Tube technology

To meet the increasing demand for dependable UHF power, RCA has developed Cermolox Tubes, a wide line of coaxial, ceramic-metal beam power tubes with precision-aligned grids. These Cermolox tubes are especially well suited to the requirements of aircraft, missile and guidance applications in CW, Pulse, and Hard-Tube-Modulator service.

Already they have set an enviable record of performance in such exacting applications. In Pioneer V, for instance, Cermolox tubes were used in the guidance systems, and in the satellite's high-power transmitter.

Some outstanding features of RCA Cermolox tubes which contribute to long life and reliability are:

- Precise alignment of grids for outstanding efficiency.
- Coaxial-electrode structure adaptable for use either in coaxial-cylinder or parallel-line circuits.
- Exceptionally sturdy structure.
- Low rf-loss ceramic insulation.
- High temperature operation.
- Brazed construction involves no spot welding and assures low rf losses and low internal stresses.
- Compact, ceramic-metal construction.
- Flexibility of cooling techniques: conduction, liquid, and forced air (with RCA's high-efficiency radiator).

The family of RCA Cermolox tubes is shown in the adjacent table. For more information, contact the RCA Field Office nearest you.

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RCA CERMOLOX BEAM POWER TUBES

Type	Max. Plate Input Watts	Max. Freq. at Max. Ratings	Max. Plate Diss. Watts	Heater Volts/ Amperes
CW APPLICATION				
A-2678*	50	3,000	25	6.3/1
A-2582-A*	50	3,000	25	12.6/.49
6816	180	1,215	115	6.3/2.1
A-2261* Conduction Cooled	180	1,215	115	6.3/2.1
A-2673* Ruggedized Conduction Cooled	180	1,215	115	6.3/3.0
7457 Ruggedized	180	1,215	115	6.3/3.0
A-2635* Conduction Cooled	180	2,000	115	26.5/.52
6884	180	1,215	115	26.5/.52
7650	1,250	1,215	600	6.3/7.5
A-2663* Conduction Cooled	1,250	1,215	600	6.3/7.5
7213	2,500	1,215	1,500	5.5/17.5
A-2545-A*	88,000	400	10,000	8/88
PULSED RF APPLICATION				
A-2587-A*	3,750	3,000	25	12.6/.41
7649 Ruggedized	9,000	1,215	115	6.3/3.0
7651	72,000	1,215	600	6.3/7.5
7214	180,000	1,215	1,500	5.5/17.5
A-2581-A*	2,000,000	600	10,000	18/12
HARD-TUBE-MODULATOR APPLICATION				
A-2638*	8,000	–	115	6.3/3.0
A-2624* Ruggedized	60,000	–	600	6.3/7.5
A-2627-A* Ruggedized Conduction Cooled	300,000	–	1,500	5.5/17.5
A-2625* Conduction Cooled	1,500,000	–	10,000	18/12
SSB APPLICATION				
A-2681*	650	500	250	6.3/2.6

*Development Type—Available on Sampling Basis

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and before and during re-entry, requires 50 lb. thrust and probably will require augmentation from another source.

AiResearch specifies delivery of the system described above one year from the date of go-ahead. NASA has announced that the first Apollo flights will be phased in by 1962 just as Project Mercury ends (AW Aug. 29, p. 26).

Four separate methods of prime movers, or power sources, to deliver the required 3 kw. of continuous power have been considered by AiResearch in its proposal.

These are, in addition to the open cycle, hydrogen-oxygen system, an open cycle, pure hydrogen system; open cycle, fuel cell hydrogen-oxygen system, and a closed cycle, solar powered system.

Advantages and disadvantages of each system have been considered.

Regardless of the power system used, AiResearch estimates that the environmental control system will weigh an estimated 770 lb. The basic system consists of a fan for compartment circulation, filters to remove odors, carbon dioxide absorber, heat sink (heat exchanger), and a water separator. Also included are pressure controls and an oxygen supply. Pressurization is accomplished by adding nitrogen from a storage tank to make up for leakage.

Rather than the pure oxygen atmosphere to be used for Mercury, for which AiResearch subcontracted to McDonnell Aircraft Co., the proposal calls for an oxygen-enriched atmosphere, with pressure equivalent to 8,000 to 10,000 ft. Carbon dioxide removal from the cabin will not be accomplished by the lithium hydroxide method employed in Mercury because of the length of the mission and the size of the crew. A system using regenerative materials is considered or a condensation process such as used in water removal. Very cold temperatures are needed for the latter but details are not beyond working out, officials said.

Heat Sink

Depending on the power system, the heat sink can be an expendable evaporant, cryogenic fuel, or outer space. However, regardless of the power system or the heat sink used, the weight and basic configuration of the environmental system remains essentially unchanged except for the heat sink heat exchanger.

The open cycle, hydrogen-oxygen power system favored by AiResearch would weigh 2,260 or 3,080 lb. total if integrated with the environmental system. A disadvantage is that it has the complexity of having two propellants and requires an additional source for supplementary power when 50 lb. thrust is needed for attitude control.

As a power source, the hydrogen sys-

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Higher joint strength allowables, close blind side clearance, and the widest grip range available—only with the Cherrylock Team—result in better fastening at lower cost. The Cherrylock Team provides the strongest mechanical lock—flush fracture rivet available. Positive visual inspection after installation—with grip length marked on the rivet head—is offered only by the Cherrylock Team.

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For technical data on the Cherrylock Team of rivets, write Cherry Rivet Division, Townsend Company, Box 2157-N, Santa Ana, Calif.

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tem appears the simplest because of the high heat capacity the fuel possesses when stored cryogenically. However, a power system operating on hydrogen alone cannot sustain itself on the feedback of its own generated energy because it must rely on additional external energy to heat the fluid so that the required power output may be obtained. This could be suitably accomplished by considering a recuperative system incorporating a low temperature heat exchanger at the hydrogen tank exit which is heated by a portion of the turbine exhaust fluid.

The disadvantage of the pure hydrogen system is that the low energy of the fuel results in a high system weight. AiResearch estimates that a system using pure hydrogen as fuel would weigh 4,395 lb., primarily because 3,000 lb. of hydrogen would be needed for the two-week mission.

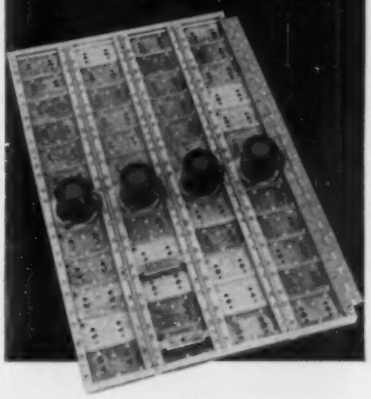
An open cycle, fuel cell system in which chemical energy of fuel is converted directly into electricity has the

Life Sciences for Space Uses

EXTENT OF KNOWLEDGE — FALL 1960

AREA OF INTEREST	STRESSORS	INADEQUATE FOR MANNED SPACE FLIGHT	ADEQUATE FOR MANNED SPACE FLIGHT OF:									
			HOURS			DAYS					YEARS	
			1	3	10	1	3	10	30	100	1	3
BIOPHYSICS	Temperature Limitations									X		
	Pressure and Partial Pressures						X					
	Relative Humidity								X			
	Accelerations											
	Linear										X	
	Angular				X							
	Radial					X						
	Accelerations As Above After Weightlessness				X							
	Weightlessness		X									
	Radiation											
	Gonadal Dosage Effects						X					
	Total Body Effects									X		
	Air Ionization in Space Vehicle								X			
	Noise									X		
	Vibration								X			
	Effects of Combined Biophysical Stressors	X										
BIOCHEMISTRY	Metabolism								X			
	Energy Requirements									X		
	Water Cycle								X			
	Food-Waste Cycle							X				
	Air Cycle								X			
	Atmosphere						X					
	Toxicology											
	Materials, Finishes and Processes								X			
	Drugs										X	
	Odors						X					
	Chemicals and Fuels							X				
	Effects of Combined Biochemical Stressors	X										
PSYCHO-PHYSIOLOGY	Maintenance of Muscle Tone						X					
	Physical Effort Required for Tasks							X				
	Work-Sleep-Recreation Cycle							X				
	Fatigue											
	Physical									X		
	Emotional					X						
	Disorientation					X						
	Effects of Combined Psychophysiological Stressors	X										
SPACE VEHICLE OPERATION	Cabin Space Requirements								X			
	Man-Machine Relationship					X						
	Emergencies											
	Fire and Explosion									X		
	Decompression										X	
	Illness and Injury									X		
	Major Environmental Control System Failure	X										
	Attitude Control Failure	X										
	Integration of Environmental Control Systems With Other Vehicle Systems	X										

Environmental conditioning *for* *detection systems*



AiResearch cooling of airborne detection systems is accomplished by an extremely reliable, compact unit which is both an air-cooled cold plate and mounting structure for the detection system's transistorized power supply.

This lightweight package weighs 7.2 lb., and has a heat rejection of 500 watts. It consists of four AiResearch Minifans and an all-aluminum structure with 44 separate modules. Each module is electrically isolated and may be removed individually for quick, easy replacement.

AiResearch is the leading designer and manufacturer of such advanced electronic conditioning equipment and systems. This production unit is one example of the broad production-proven capability of AiResearch in providing extremely reliable, lightweight, compact cooling packages for aircraft, missile, space and ground support applications.

Environmental conditioning equipment has been produced for the following electronic systems:

Detection · Communication · Control · Ground Support · Guidance

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advantage of low power system weight but would require a supplementary heat sink and a separate attitude control system because there would be no exhaust available. The over-all system therefore would be heavier than the integrated hydrogen-oxygen system by 95 lb., totaling 3,175 lb. An added disadvantage, AiResearch says, is that development of the fuel cell is not very far along and could not be available until 1964.

Solar power also is considered as a source to provide the 3 kw. of electrical energy. Light weight is the primary point in favor of this system, which weighs only 980 lb. but requires an independent power system for launch and re-entry and a separate attitude control system. Operation is a closed rankine mercury-vapor cycle with a large solar collector used to boil the mercury which powers the prime mover or generator.

Another large radiator which condenses the vapor radiates to outer space. Environmental cooling is accomplished through the space radiator, supplemented with hydrogen as an expendable coolant. However, when the solar power system is integrated with the environmental control system, the estimated weight is 3,310 lb., slightly heavier than the hydrogen-oxygen system.

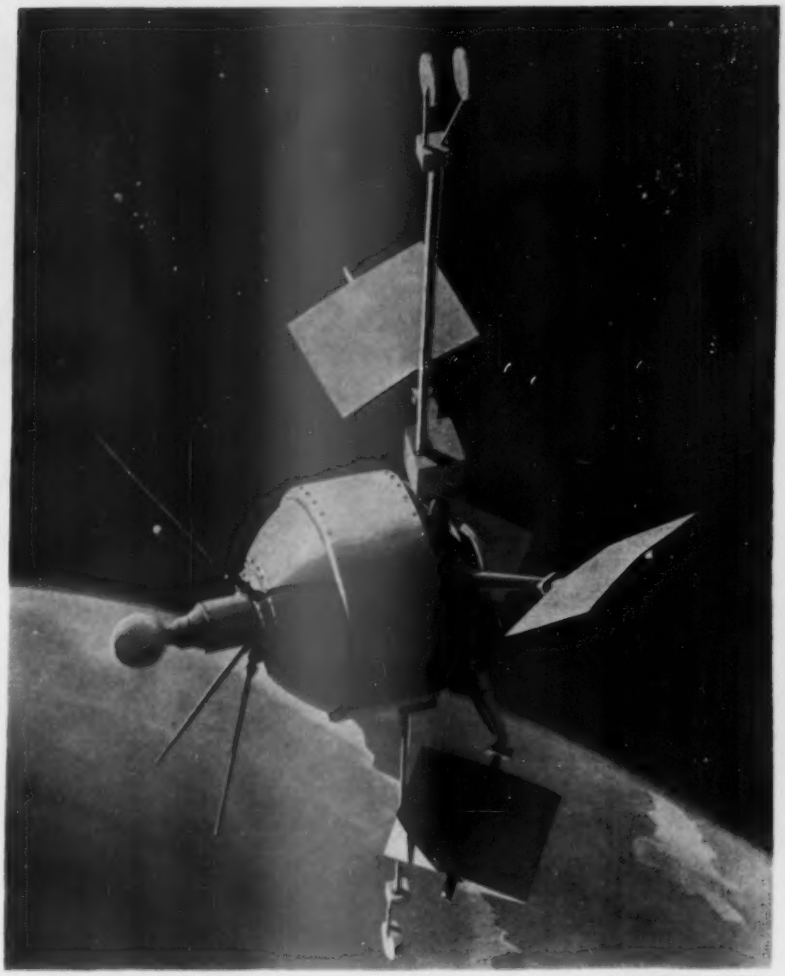
U.S.-U.K. Cooperate On Satellite Design

Washington—Detail design has begun for the first international satellite, in which a U. S. Scout vehicle will launch a variety of British experiments to measure ionospheric and cosmic ray characteristics.

Structure for the 150-lb. payload is being built by National Aeronautics and Space Administration's Goddard Space Flight Center, which also will integrate experiments being assembled by three British universities, with the Royal Society Committee on Space Research coordinating the British work. Payload is designated S-51 by NASA and UK Scout 1 by Britain.

Satellite configuration has most experiments carried outside the spherical structure, which is 23 in. in diameter. Two Imperial College experiments will be carried on top of the sphere. Uppermost is a 4-in. ball containing instruments to measure ion mass. Directly beneath is a cylinder housing a cosmic ray energy spectrometer.

Extending from the satellite housing are two 4-ft. booms and four solar paddles. On the end of one boom is a pair of disks to measure electron density in a University of Birmingham experiment. The other boom is tipped with a single disk designed by University College of London to measure electron temperatures.



FIRST international satellite will integrate experiments prepared by three British universities within 150-lb. payload to be built by National Aeronautics and Space Administration.

Non-oriented solar paddles have a surface area of 5-6 ft. to power the multiple experiments, which will have a constant power drain of 2.5 watts.

Other experiments on the structure skin and inside the package are three solar radiation sensors and two X-ray counters. Four telemetry antennas extend from the top of the structure at an angle of approximately 45 deg.

The satellite will be launched at an angle of 55 deg., aimed for an orbit with a 200-mi. perigee and 600-mi. apogee.

Royal Society and NASA have established a joint working group (AW Aug. 29, p. 92) which is meeting periodically as the first payload is developed. This group also is discussing experiments for two additional satellites which will be instrumented by the British for Scout launches.

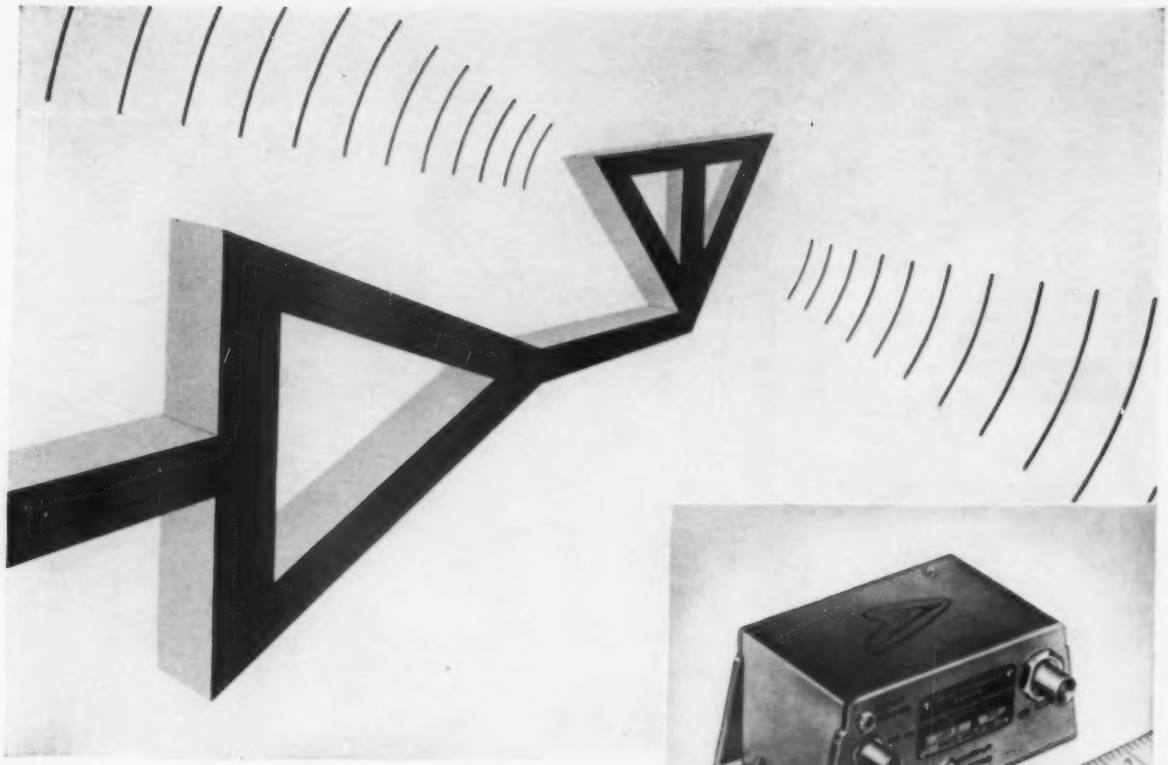
NASA's contribution includes satellite electronics and mechanical instrumentation. Bristol Aircraft Guided Weapons Division and Pye, Ltd., are providing circuitry for several British experiments.

USAF Asks Approval To Buy STL Property

Washington—Air Force has formally requested congressional approval of its plan to pay $23.5 million for facilities of Space Technology Laboratories, wholly owned subsidiary of Thompson Ramo Wooldridge, Inc., for use by Aerospace Corp., USAF's new nonprofit organization which is taking over the functions of STL as manager of future ballistic missile and space programs.

The original cost of the STL property, which includes approximately 40 acres and nine buildings in El Segundo, Calif., totaled $20,270,645.

The Army Corps of Engineers appraised the replacement cost at $20,350,000. STL appraisers estimated the replacement value at $35,360,000, including a replacement cost of $26,275,000, plus approximately $9 million for items such as relocation costs, mortgage prepayment penalties, capital gains taxes, and state franchise taxes.



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You can get this new amplifier in two models, for either 6.3 or 28 volt filament—each available with either integral output filter . . . integral output filter plus integral line filter . . . or without any filters.

The 1114 is ready for immediate delivery. Detailed technical bulletins and evaluation models are available. Please call the American Bosch Arma sales office in Washington, Dayton or Los Angeles. Or contact Tele-Dynamics Division, American Bosch Arma Corporation, 5000 Parkside Avenue, Philadelphia.

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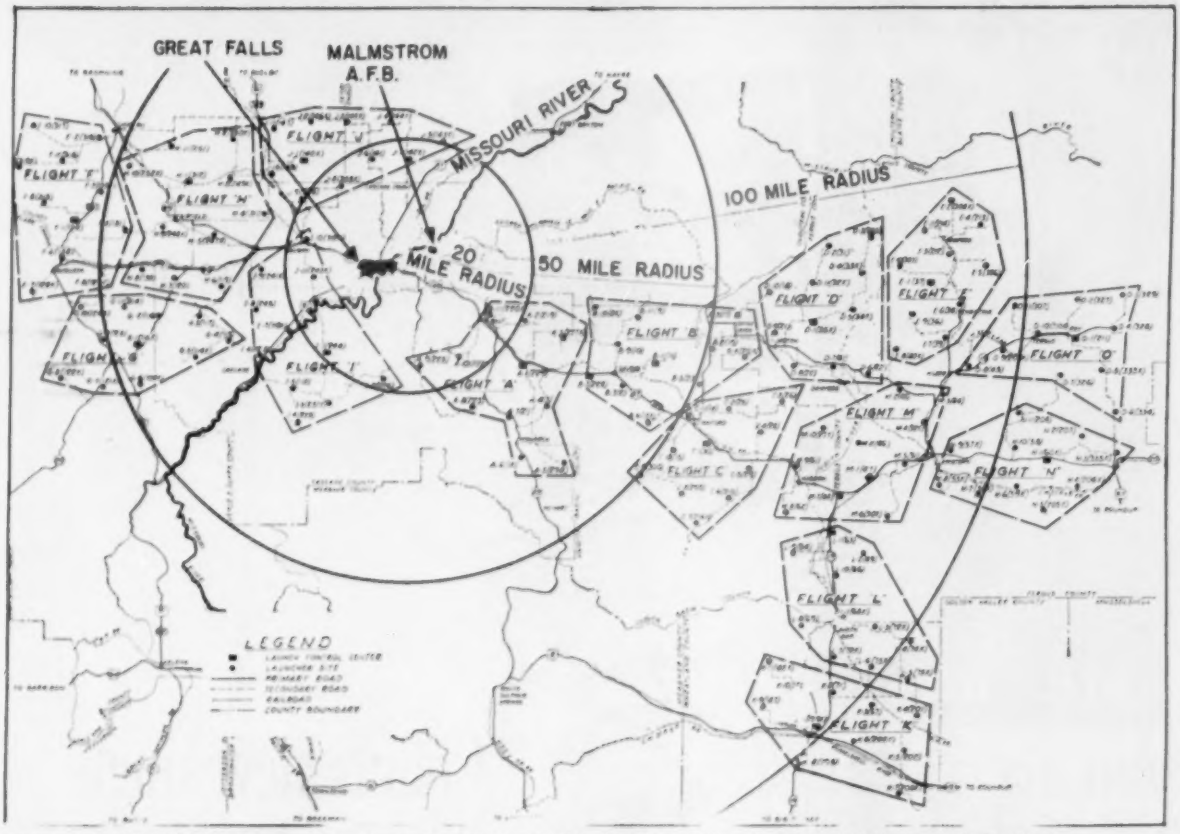

FIFTEEN MINUTEMAN flight complexes eventually will be established within a 125-mi. radius of Malmstrom AFB, Montana.

Missile Site Builders Face Slippage Fines

By Russell Hawkes

Los Angeles—Construction contractors who fail to meet completion dates will be penalized $2,000 of "liquidated damages" for each day of slippage on each uncompleted launcher or control facility in the 150-missile, $40-million Minuteman base construction program around Malmstrom AFB, Mont.

Drive Against Delays

The penalties are part of the drive by Army Corps of Engineers Ballistic Missile Construction Office to prevent the delays that have hampered ballistic missile base programs thus far and will indemnify the Corps for the heavy costs incurred by delays. Liquidated damages will also be charged for delays on bases for Martin Titan II SM-68B. The rate has not been announced. Brig. Gen. Alvin C. Welling, BMCO commander, warned builders of the obstacles they will be expected to overcome in a bulletin of advance information for potential bidders.

He said, "I want to re-emphasize the national urgency of the project, the managerial complexity, the magnitude and demanding speed encompassed in the construction effort. The wide dispersion of construction sites, close construction schedules under adverse weather conditions, and precise dimensioned tolerances exceeding those encountered in normal construction practice, all demand a skilled and competent organization-in-being capable of organizing and carrying through the work to a timely and acceptable completion.

"The Great Falls area of Montana has a severe winter climate. According to present schedules, work will not get under way until mid-December, which means a winter start in a difficult cold-weather construction region. The allowable construction time for the early flights (a flight consists of a launch control center and 10 silo launchers) is short and will demand a high degree of mobilization of men, equipment and materials at the very outset of the work. The construction approach must be an explosive, large-scale operation immediately following award in order to save irretrievable construction time."

Successful bidders on construction contracts will be expected to start excavations within 10 days of the go-ahead from BMCO. The terms of contracts will require that construction of each launch control area be completed 30

Preliminary Construction Schedule

15 MINUTEMAN FLIGHTS

Installation	Beginning Date	Completion Date
Flight A	Dec. 15, 1960	June 30, 1961
Flight B	Dec. 15, 1960	June 30, 1961
Flight C	Dec. 15, 1960	Aug. 31, 1961
Flight D	Jan. 1, 1961	Oct. 31, 1961
Flight E	Feb. 1, 1961	Nov. 30, 1961
Flight F	Feb. 1, 1961	Nov. 30, 1961
Flight G	Feb. 1, 1961	Dec. 31, 1961
Flight H	Feb. 1, 1961	Jan. 31, 1962
Flight I	Mar. 1, 1961	Mar. 31, 1962
Flight J	Mar. 1, 1961	Mar. 31, 1962
Flight K	Apr. 1, 1961	Apr. 30, 1962
Flight L	Apr. 1, 1961	Apr. 30, 1962
Flight M	May 1, 1961	May 31, 1962
Flight N	May 1, 1961	May 31, 1962
Flight O	May 1, 1961	May 31, 1962

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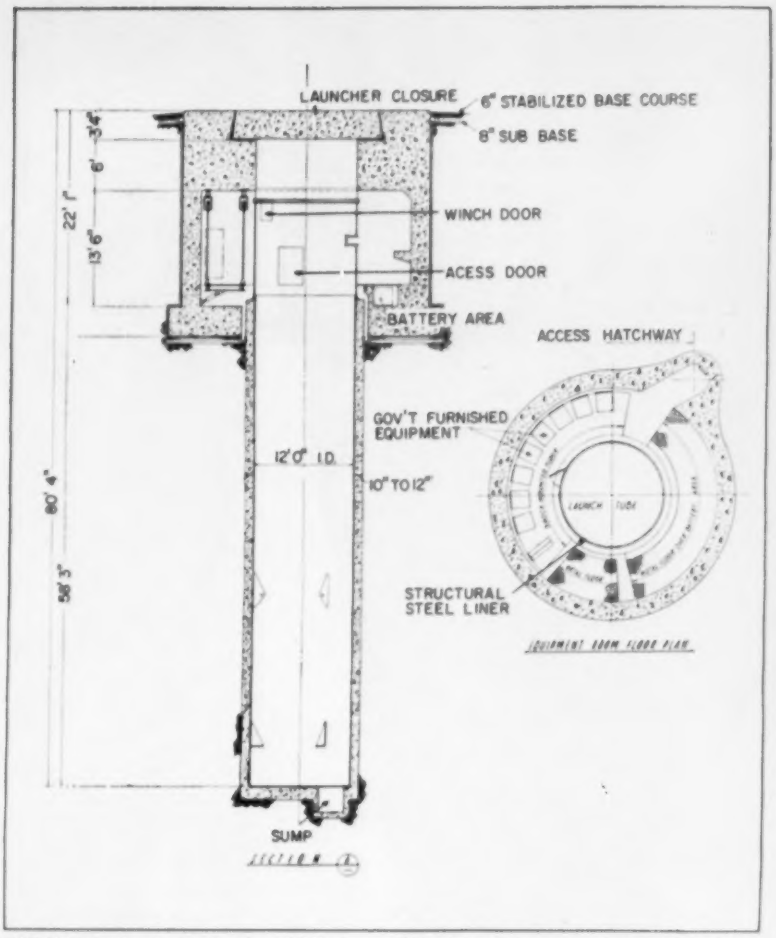

TOP 25 FT. of each missile silo at Malmstrom AFB will contain an annular equipment area. Sliding steel and concrete tube closure will cover each 80-ft.-deep silo.

days before the last launch tube in its flight. Fifteen Minuteman flights will eventually be established within a 125-mi. radius of Malmstrom. The flights will be identified by letters "A" through "O." Construction of flights A, B, and C was to have started Dec. 1, but has been postponed two weeks. According to the preliminary schedule, flights A and B were to be completed by the end of June, 1961, and flight C was to be finished two months later.

BMCO is inviting bids this month and plans to open them on Dec. 6. Bids will be accepted only from contractors on a pre-qualified bidders' list established by the Corps of Engineers. Following an Army precedent set years ago by the Quartermaster Corps, Gen. Welling created the list to make sure contractors have the "competent organization-in-being" he speaks of in the advance information for bidders.

Welling has been instructed to eliminate "contract brokers" and companies which cannot fulfill their contracts from the ballistic missile base construction program.

Each silo launcher will be 80 ft. deep to accommodate the Minuteman missiles which are about 60 ft. long. Around the top 25 ft. of each silo will be an annular equipment area. The walls of the 12-ft.-dia. silo below the equipment area will be made of foot-thick poured or precast reinforced concrete.

The walls of the upper 25 ft. will be much thicker since they are more exposed to enemy attack. Allowable variation from true vertical for the concrete tube will be 1 in 500. A heavy sliding steel and concrete tube closure will cover each silo. Boeing Airplane Co., assembly and test contractor for Minuteman, will provide the closure actuating mechanism and missile support system. It will be possible to enter the tube through a hinged, hydraulic-actuated hatch in the tube closure. A trolley beam and 500-lb. hoist will be installed in the equipment area for moving equipment about in the launcher.

Contractors will install a 12-ft. x 24-ft. prefabricated metal support build-

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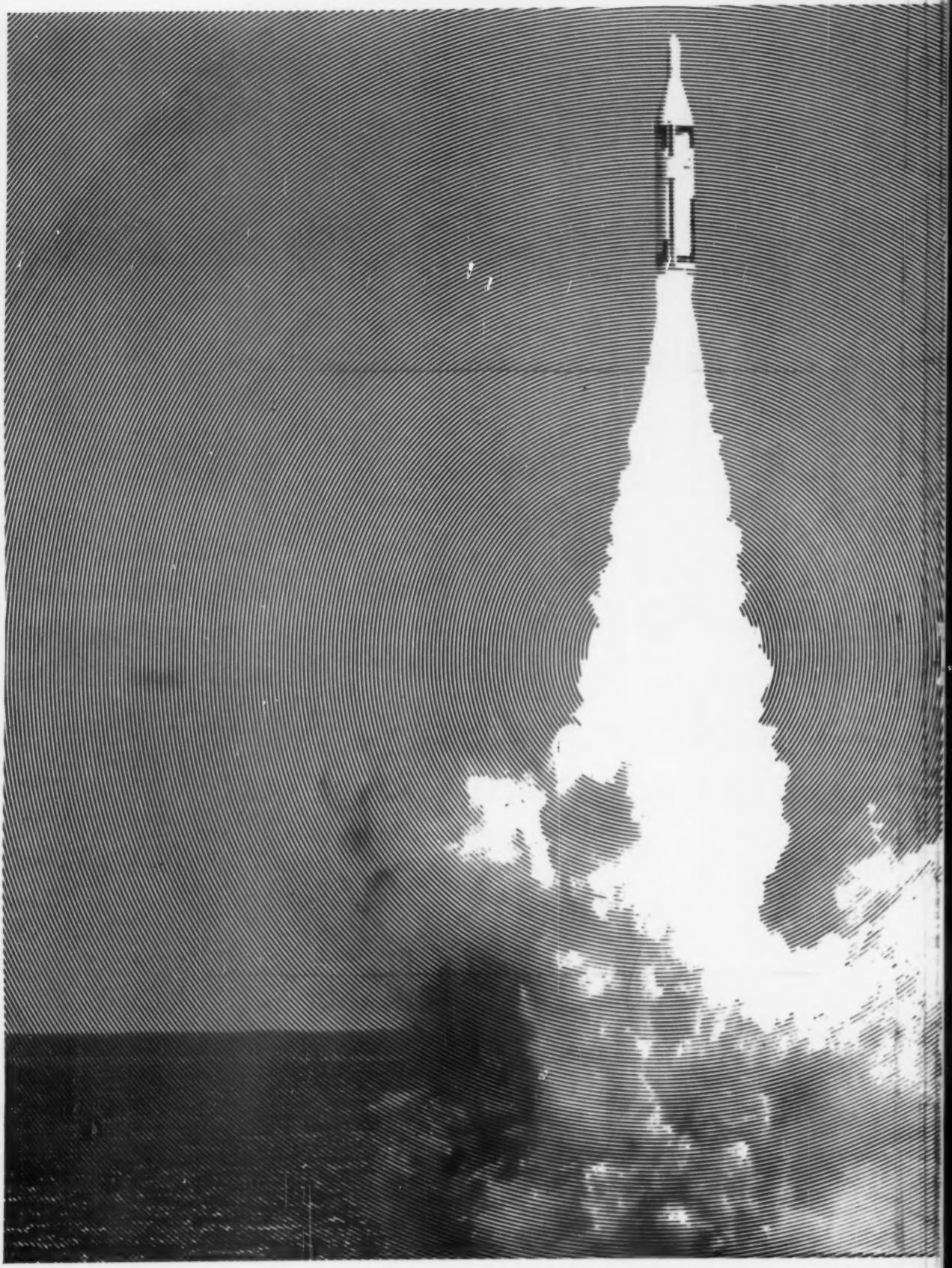

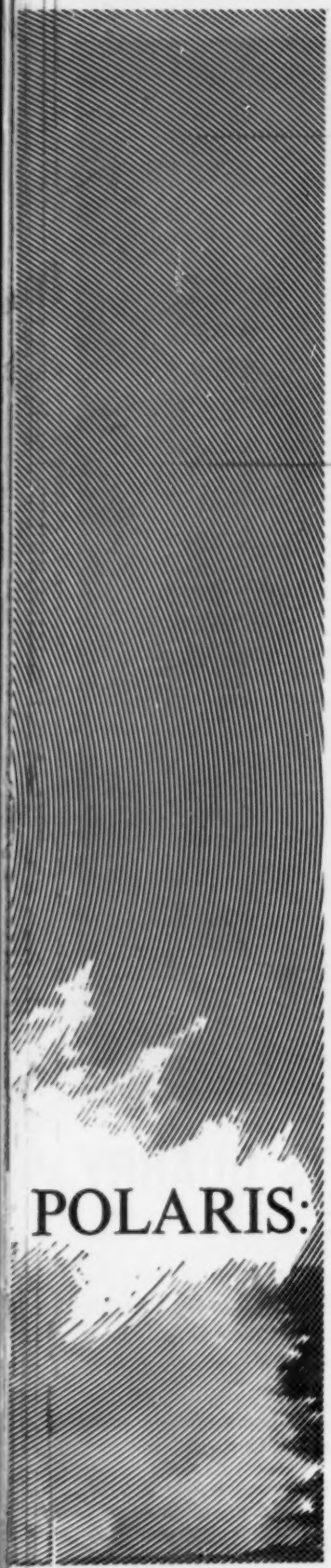

Three years ago, the U.S. Navy handed American scientific and industrial leaders a formidable task. Problem: To develop and build a submarine-launched, intermediate-range ballistic missile with extreme accuracy and dependability.

Hundreds of organizations over the land pooled their talents and resources—under the direction of the Special Projects Office of the Navy.

The result: Polaris—today one of the world's most potent defense weapons. A unique marriage of space and sea power and a unique marriage of scientific and industrial ingenuity.

The Lockheed-built Polaris Missile has demonstrated accuracy in a great number of test firings using the guidance system designed by the MIT Instrumentation Laboratories.

Hughes initially contributed to the success of these firings as one of the suppliers of the electronics for the guidance system produced by the General Electric Company.

Hughes is today a prime contractor for production of complete Polaris guidance systems. These systems, incorporating Minneapolis-Honeywell produced inertial platforms, are now being built at the Hughes El Segundo plant.

The Polaris Missile is a major factor in the Free World's effort to maintain the peace. Patrolling deep beneath the seas, the Polaris Missile System will be a mighty, but silent force for freedom.

VIDEOSONIC *assembly techniques, developed by Hughes manufacturing engineers, are the most important advance in production line flow since the standard assembly track. Used to build Hughes Polaris guidance systems, these techniques regularize flow, maintain reliability and reduce worker fatigue.*

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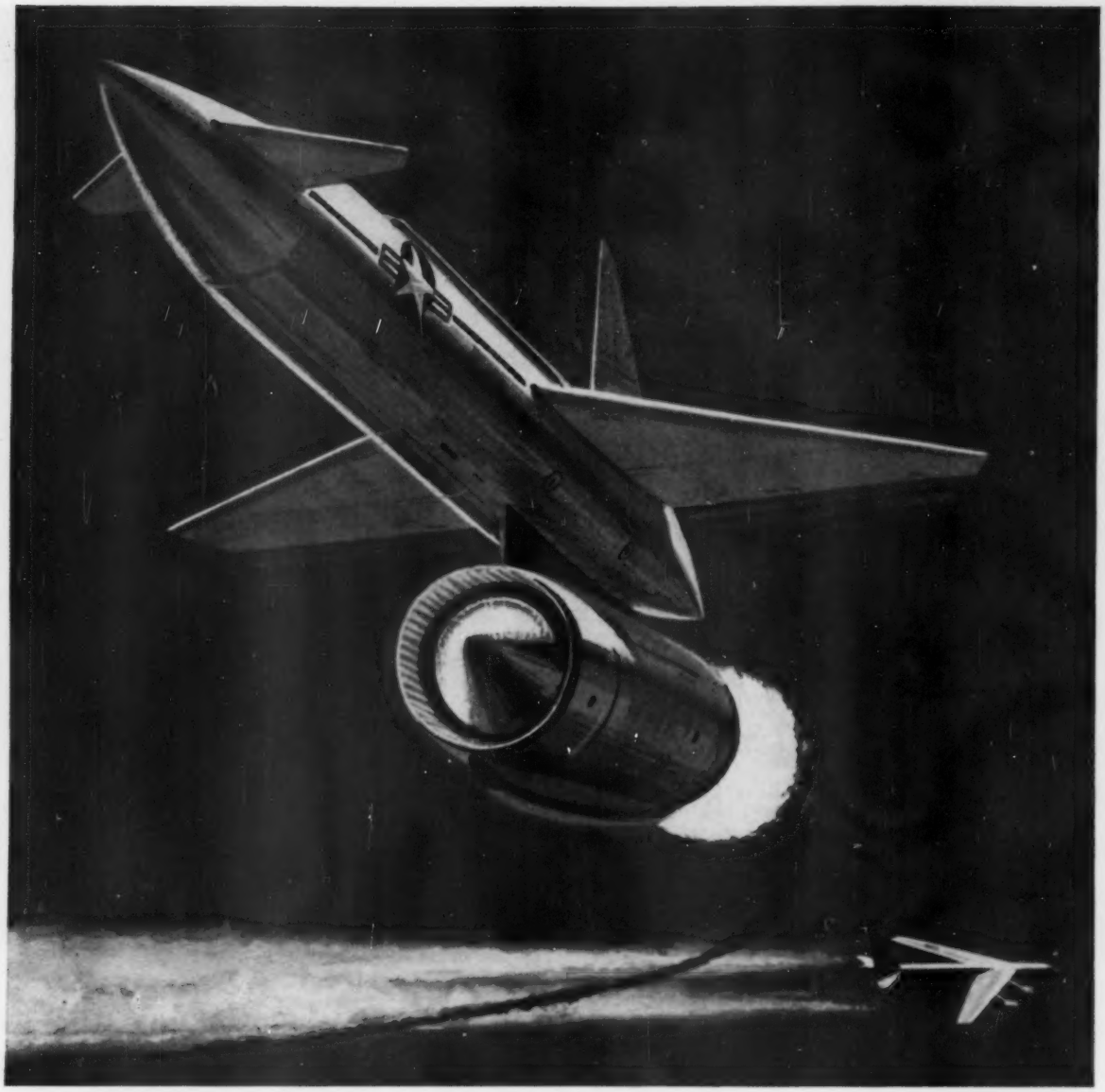

HOW SAC'S HOUND DOG CONFUSES ITS QUARRY

When the GAM-77 HOUND DOG strategic missile leaps into action from a B-52G intercontinental bomber, its pre-set controls can veer it off in a direction *away* from the target. It can change course and altitude. Then, with enemy defenses confused, it can turn suddenly and bear down on the target at supersonic speeds. Its guidance system can't be jammed... can't be decoyed. It can reach out hundreds of miles to destroy its quarry.

Outstanding capabilities such as this make the GAM-77 HOUND DOG missile an extremely valuable weapon for SAC. The HOUND DOG has already been tested and proved in flight conditions. It is operational hardware *in being*. And in addition, it has growth potential in range, speed, and payload stretching through many years to come.

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Downey, California

ing on the surface near the mouth of the hole.

It will contain a 50 kw. diesel-electric generator and a 10-ton capacity water chiller to cool the missile warhead, guidance and ground support electronics.

The launch control facility for each flight will consist of an underground launch control center with the floor suspended from the ceiling by springs to isolate equipment from earth-conducted shock waves generated by enemy weapons or perhaps by the launch of the flight's own missiles from the nearest silos. Equipment will include an oxygen generator, and 5,500 gal. of stored water. Access will be through a concrete shaft from a wood frame support building on the surface. A 2,000-lb.-capacity elevator will install and remove equipment. A smaller reinforced concrete escape tunnel will lead to the surface from the other end of the center and will be covered by a blast door.

The launch support facility on the surface will include 15 buildings housing personnel, stores and equipment. Living facilities will include cooking ranges, dishwashers, sewage disposal facilities, etc. The installation will also have a blast damper.

Changes are still being made in the design details of facilities for Minuteman complexes and contractors have been warned not to consider preliminary drawings final. Revisions being considered include enlargement of the underground concrete capsule for the launch control center and the movement of more equipment rooms underground.

Oil Bath Grinding Improves Steel Strip

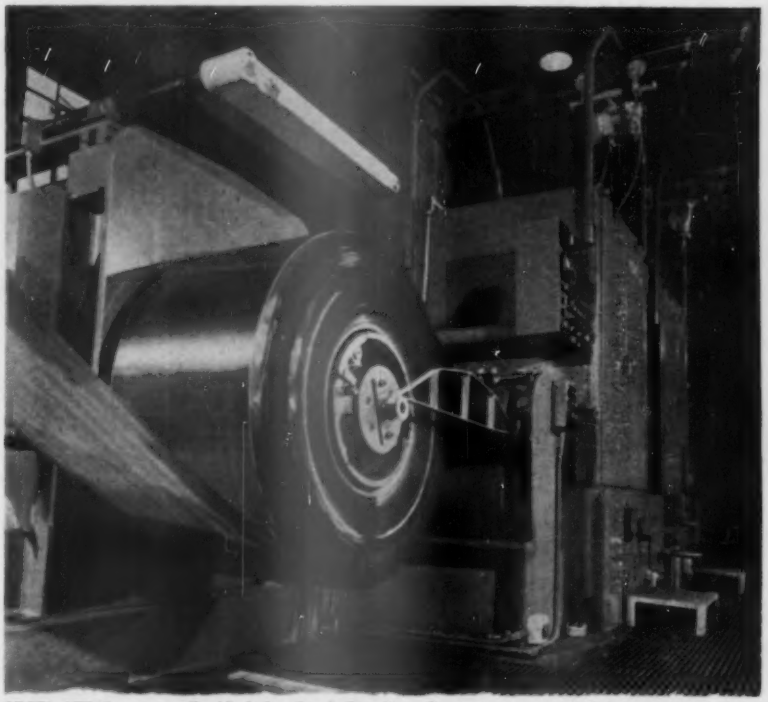
Higher quality stainless steel strip is promised to the aircraft and missile industry with an oil bath grinding method which grinds strip steel to thickness variations of less than 0.0005 in.

Wallingford Steel Co., Wallingford, Conn., is producing the steel strip with coated abrasive belts running in oil. The crown grinding equipment is produced by the Hill Acme Co. to designs modified by the Behr-Manning Division of Norton Co., Troy, N. Y.

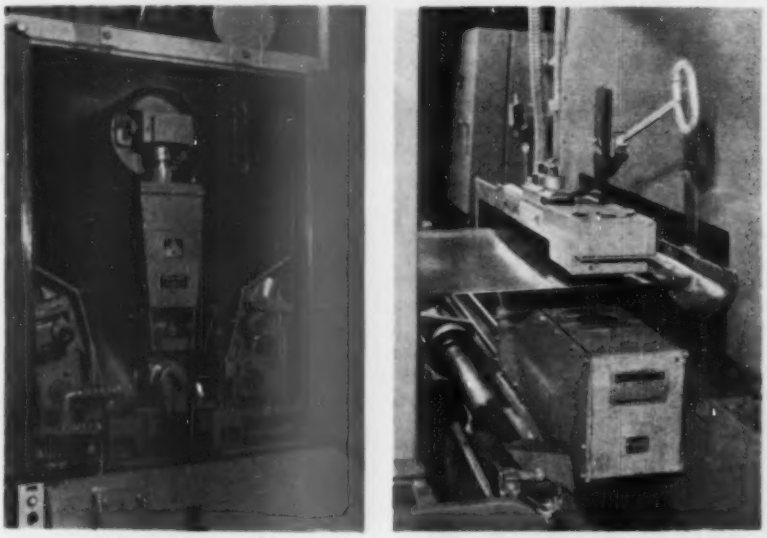
The crown of the strip steel is removed by means of two abrasive belt grinders running in oil. This method is said to produce higher quality work in less time than dry grinding techniques which require two grinding lines.

The single grinding line consists of two 60-hp. vertical grinders running in tandem, each driving 30 x 126-in. cloth belts with aluminum oxide or silicon carbide abrasives. The belts grind in a 65 gpm. flood of sulfur-chlorinated oil from a 4,000-gal. reservoir. To obtain higher polished finishes, a less aggressive glue-bonded belt of cloth or paper is employed.

Flattening of the steel strip as it approaches the abrasive belt is achieved with an endwise tension of 30,000 lb. The strip is bent at an angle of 20 deg. by being forced under "V" break rolls as it approaches and leaves the grinding point. Hydraulic pressure against an 8-in.-dia. work roll forces the strip against the abrasive belt. Wallingford's equipment can handle strip to a thickness of 0.240 in. and to a maximum width of 27 in. Strip is fed to the abrasive belts at speeds between 6 and 36 fpm., depending on depth of cut, type of stock and surface finish desired.



STEEL STRIP comes off wide-belt oil grinding line. Protective paper is fed to steel coil from left. Wallingford Steel grinds strip up to 27 in. wide.



COATED ABRASIVE BELT 30 in. wide removes crown at surface speed of 4,200 fpm. using knurled steel contact roll (left). X-ray thickness gage (right) traverses strip.

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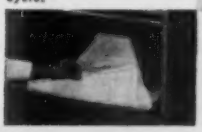

C. The first print is automatically delivered in 30 seconds, subsequent prints (of the same or different drawings) every 15 seconds.

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In addition to ASW systems, Vought Aeronautics develops missiles, aircraft and other products for defense.

CHANCE VOUGHT AERONAUTICS DIVISION DALLAS, TEXAS

Firms Appeal $110 Million Excess Profits

By Katherine Johnsen

Washington—Seven aircraft companies now have over $110 million in excessive profits cases appealed to the U. S. Tax Court from Renegotiation Board decisions, and they probably will remain in litigation for years.

Two appeals filed recently with the Tax Court—involving $4.2 million by the Martin Co. and $4.1 million by Lockheed Aircraft Corp.—boosted the total over the $110 million mark. These two were the only excessive profit determinations made by the Renegotiation Board against aircraft companies for 1956.

Renegotiation Board has finished its review of the aircraft industry for 1956, and Board Chairman Thomas Coggeshall reports that the industry has been cleared for 1957 with no excessive profit determinations, with the exception of Martin and Lockheed whose cases are still being reviewed. Review of 1958 industry profits is now under way.

Coggeshall attributes the drop-off in major excessive profits determinations by the Board against aircraft firms, compared with earlier years, to two factors:

• **Tightening of procurement procedure.** "The recent cases which are coming to the Board," Coggeshall told AVIATION WEEK, "actually show lower profits than the Board was willing to allow under earlier cases—which the aircraft companies are fighting in court."

• **Capital investment.** Many of these companies in the aircraft group have been paying very conservative dividends, reinvesting 60, 70, or 75% of their earnings, and many have gone out and raised capital," Coggeshall observed. The high profits of aircraft companies, as measured by net worth, probably have been the major issue between the industry and the Renegotiation Board.

Coggeshall noted that at the end of World War II the aircraft industry without protest refunded $500 million to the government—largely determined by the yardstick of profits related to net worth.

The biggest aircraft profits case, and the most advanced in the legal process—a $33.3 million determination by the Renegotiation Board against Boeing Airplane Co.—is indicative of the time involved in litigation. It is bogged down on the side issue of "production of papers" by the Board.

The case involves four years: 1952, $9.8 million; 1953, $7.3 million; 1954, $9.7 million and 1955, $6.5 million.

The Tax Court proceeding for the first phase—$9.8 million for 1952—started in October, 1958. Since then, on the issue of Boeing's demands of "production of papers" by Renegotiation Board, the case has gone to the U. S. District Court, from there to the U. S. Court of Appeals, back to the District Court, and then again to the Court of Appeals. The Solicitor General, the legal representative of the Renegotiation Board, is now considering a request to the U. S. Supreme Court to interpret the last decision of the Court of Appeals on the "production of papers" issue.

Pending disposition of this issue, the U. S. Tax Court is tentatively scheduled to resume consideration of the first $9.8 million phase of the Boeing case on Dec. 15—over two years after the proceeding started.

The six other aircraft companies with cases pending in the Tax Court are:

• **Douglas Aircraft Co.,** $14.8 million. This includes: $4.4 million for 1953; $4.4 million for 1954, and $6 million for 1955.

• **Fairchild Engine & Airplane Corp.,** $1.6 million for 1953.

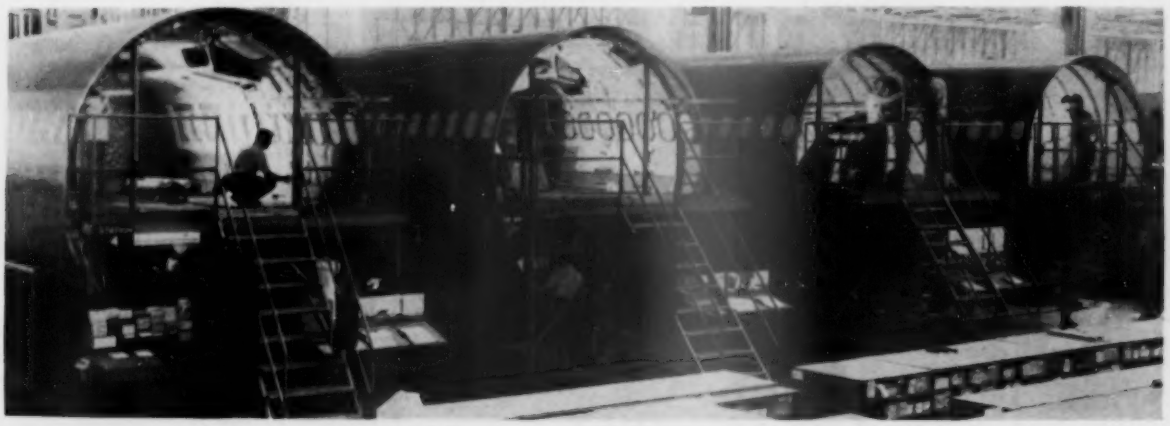
• **Lockheed Aircraft Corp.,** $15.1 million. This includes: $4.3 million for 1953; $4.6 million for 1954; $2.1 million for 1955, and $4.1 million for 1956.

• **Martin Co.,** $16.3 million. This includes: $3.2 million for 1953; $5.9 million for 1954; $3 million for 1955, and $4.2 million for 1956.

• **North American Aviation, Inc.,** $25 million. This includes: $4.9 million for 1953; $12.7 million for 1954, and $7.4 million for 1955.

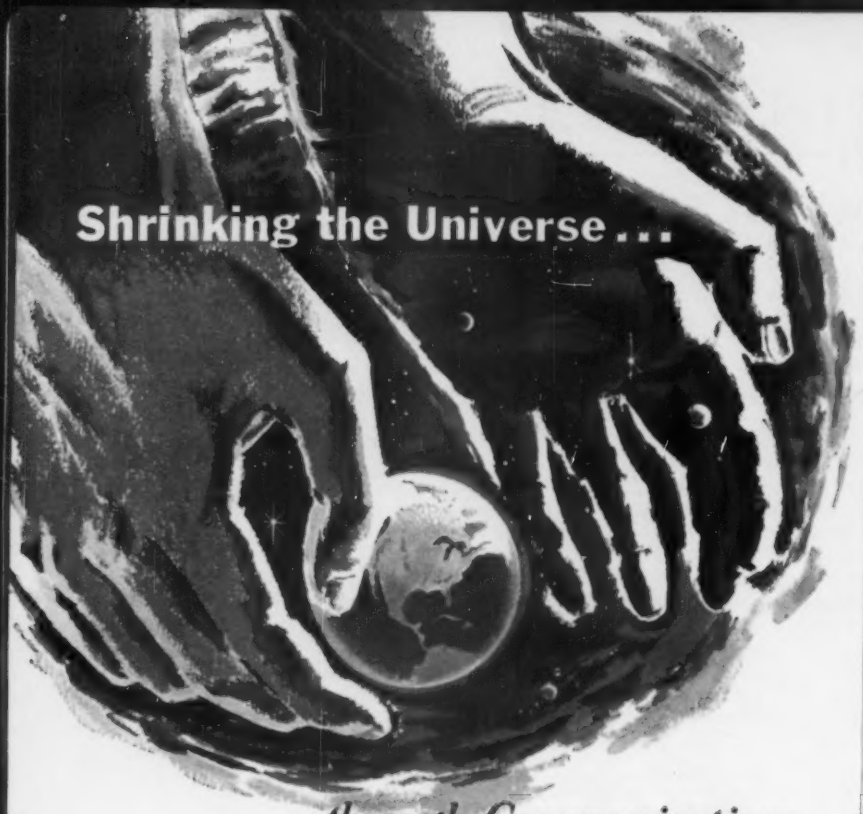
• **Temco Aircraft Corp.,** $4.2 million. This includes: $750,000 for 1952 and $3.5 million for 1953.

The $110 million in seven aircraft cases accounts for approximately 95% of the dollar-volume of Renegotiation Board determinations now being contested in the Tax Court. The other



Primary Work Stations on Convair Assembly Line

Four forward fuselage sections of the Convair 880 are shown on final assembly line at Convair (San Diego) Division of General Dynamics Corp. Installation of acoustical treatment, ducting, electrical harnesses and interior trim at these four primary work stations saves both factory space and parts inventory. There is a similar arrangement for aft fuselage sections.



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61 cases add up to a total of $8 million.

Of approximately $840 million in excessive profits determinations that the present board has made since its establishment in 1951, approximately $720 million has been refunded.

Four aircraft companies that have had major excessive profits determinations made against them have not contested them. They are:

- **Northrop Corp.,** $4.2 million for 1955.
- **McDonnell Aircraft Corp.,** $2.7 million. This includes: $1.5 million for 1951; $400,000 for 1955, and $800,000 for 1956.
- **Republic Aviation Corp.,** $3.6 million for 1952.
- **Grumman Aircraft Engineering Corp.,** $13.3 million. This includes: $1.2 million for 1950; $2.2 million for 1951; $600,000 for 1952; $4.4 million for 1953; $2.4 million for 1954, and $2.5 million for 1955. Grumman took the $6.6 million involved in the 1951 and 1953 determinations to the Tax Court, but withdrew the case last year.

In addition to the 68 pending cases, 36 other renegotiation cases have been taken to the Tax Court since 1951. They have generally been decided in favor of the Renegotiation Board:

- **Dismissed "with prejudice,"** 20 cases. This means the company withdrew the case.
- **Decided by "stipulation,"** 8 cases. This means the attorneys on both sides reached an agreement, approved by the Tax Court judge.
- **Opinions rendered,** 8 cases. These cases ranged from determinations of $30,000 to $210,000. In six of the cases, 100% of the determination made by the Board was awarded by the court. On the other two cases, the outcome was: a $37,951 determination against Walthan Screw Co. was reduced to $20,000; and a $210,000 determination against X-Ray, Inc., was reduced to $165,000.

Renegotiation Board has almost completed reviews for the annual earning periods through 1956, and all aircraft company reviews are finished. It has completed 85% of its cases for 1957—including the entire aircraft industry with the exception of Lockheed and Martin. Review of 1958 profits is 45% complete.

Financial Briefs

National Aeronautical Corp. and its subsidiary, Air-Shields, Inc., earnings for the nine months ended Aug. 31 were $537,829 on sales of $6,109,889.

D&R, Ltd., Santa Barbara, Calif., manufacturer of electronic components for airborne and ground support equipment systems, has formed a wholly-

How to use a 4-megacycle instrumentation tape recorder

Ampex's new AR-300 and FR-700 answer a whole new range of needs

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Radar, for instance, can now be tape recorded off receiver and played back repeatedly to scopes, analytical devices or radar guided equipment. Radar testing, reconnaissance and tracking are enormously aided by tape's live-playback capabilities. And for simulation and training, elusive transient phenomena now become repeatable at will.

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The essential data

The Models: AR-300 Mobile or airborne record only; FR-700 single-rack laboratory record/playback. Response: 10 cps to 4 mc (±3 db). Tape speeds: 12½ and 25 ips. Playing time: 60 minutes. Tape: 1.0-mil Mylar, 2-inch width, 10½-inch reels. Data tracks: two wideband plus two auxiliary. Electronics: all solid state. Environmental (AR-300): 10g vibration; 50,000 ft. alt.; −54°C to +55°C. Tape interchangeability: yes, among all AR-300/FR-700 recorders.

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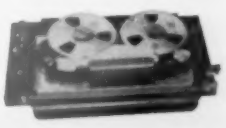

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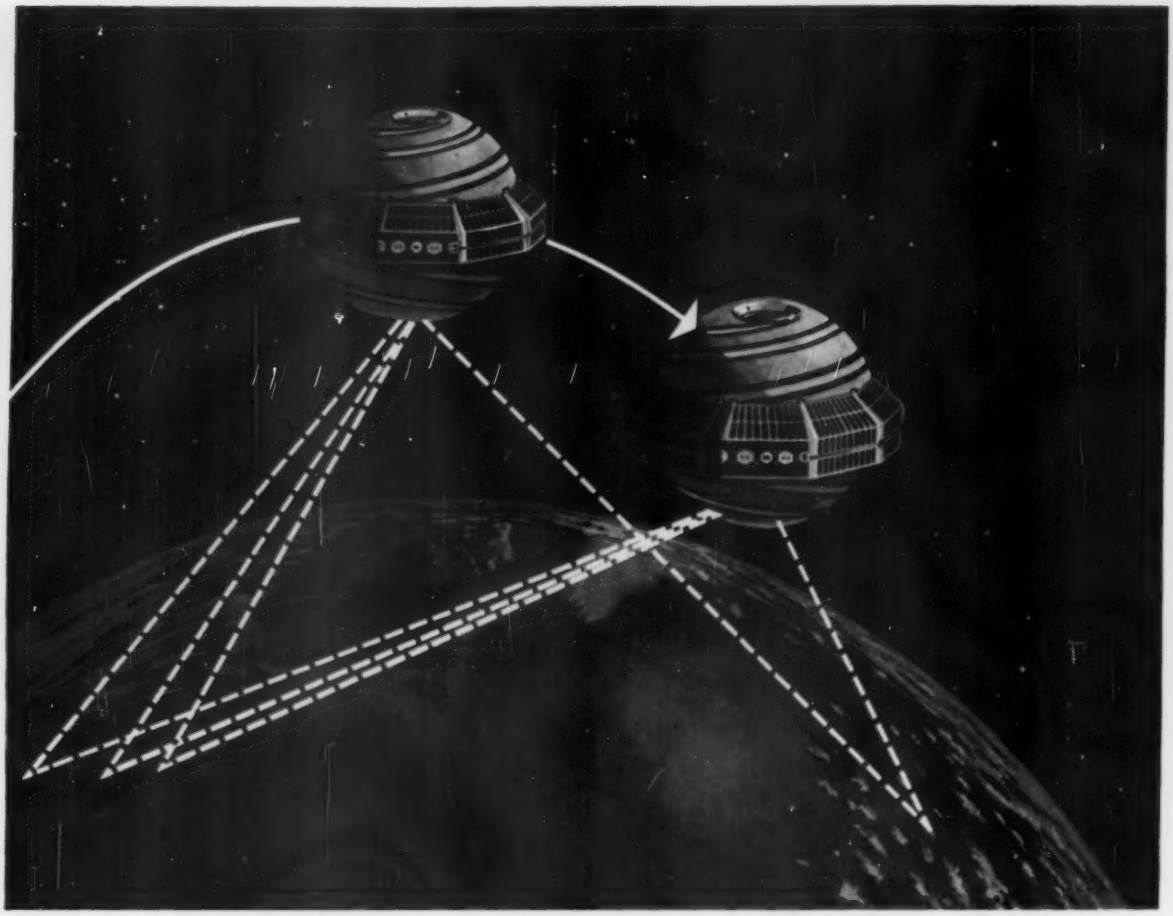

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owned subsidiary, Power Systems, Inc. The new company will specialize in miniature energy conversion systems for both commercial and military uses.

Acoustica Associates, Inc., Beverly Hills, Calif., earnings for the six months ended Aug. 31 were $121,655 on sales of $4,187,314 compared with earnings of $15,763 on sales of $2,893,503 for the similar period last year.

Perkin-Elmer Corp., Norwalk, Conn., earnings for the fiscal year ended July 31 were $1,208,085 on sales of $22,124,935 compared with earnings of $900,799 on sales of $17,514,097 for the previous year.

Collins Radio Co. earnings for the year ended July 31 were $6,560,596 on sales of $190,837,000. This compares with earnings of $3,530,845 (after preferred dividends) on sales of $117,864,139 for the previous year.

Coleman Electronics, Inc., Gardena, Calif., manufacturer of data-handling and control equipment, has acquired Audio-Videre Co., Anaheim, Calif., manufacturer of commercial magnetic tape. No details of the acquisition were announced.

Avien, Inc., Woodside, N. Y., manufacturer of instruments and controls, has acquired Electrol, Inc., Kingston, N. Y., manufacturer of landing gear and hydraulic equipment. Electrol's net assets were purchased by Avien stock.

New Offerings

Solitron Devices, White Plains, N. Y.; organized in March, 1959, the company is engaged in the business of developing and introducing, manufacturing and marketing new solid-state devices. These devices replace gas-filled or vacuum electronic tubes and selenium rectifiers in the function of current conversion from alternating current to direct current required by various electronic devices. Offering is $400,000 of 6% subordinated convertible debentures due 1967, for public sale at 100% of principal amount. Proceeds will be used to lease and move to a new plant, purchase additional equipment, hire additional scientific talent, expand research and development, retire loans, and for working capital.

Therm-Air Mfg. Co., Inc., Peekskill, N. Y.; organized in December, 1958, the company is engaged in the design, manufacture and sale of temperature and humidity control equipment for military and commercial use. Offering is 125,000 shares of common stock, for public sale at $4 per share. Proceeds will be used to discharge an aggregate

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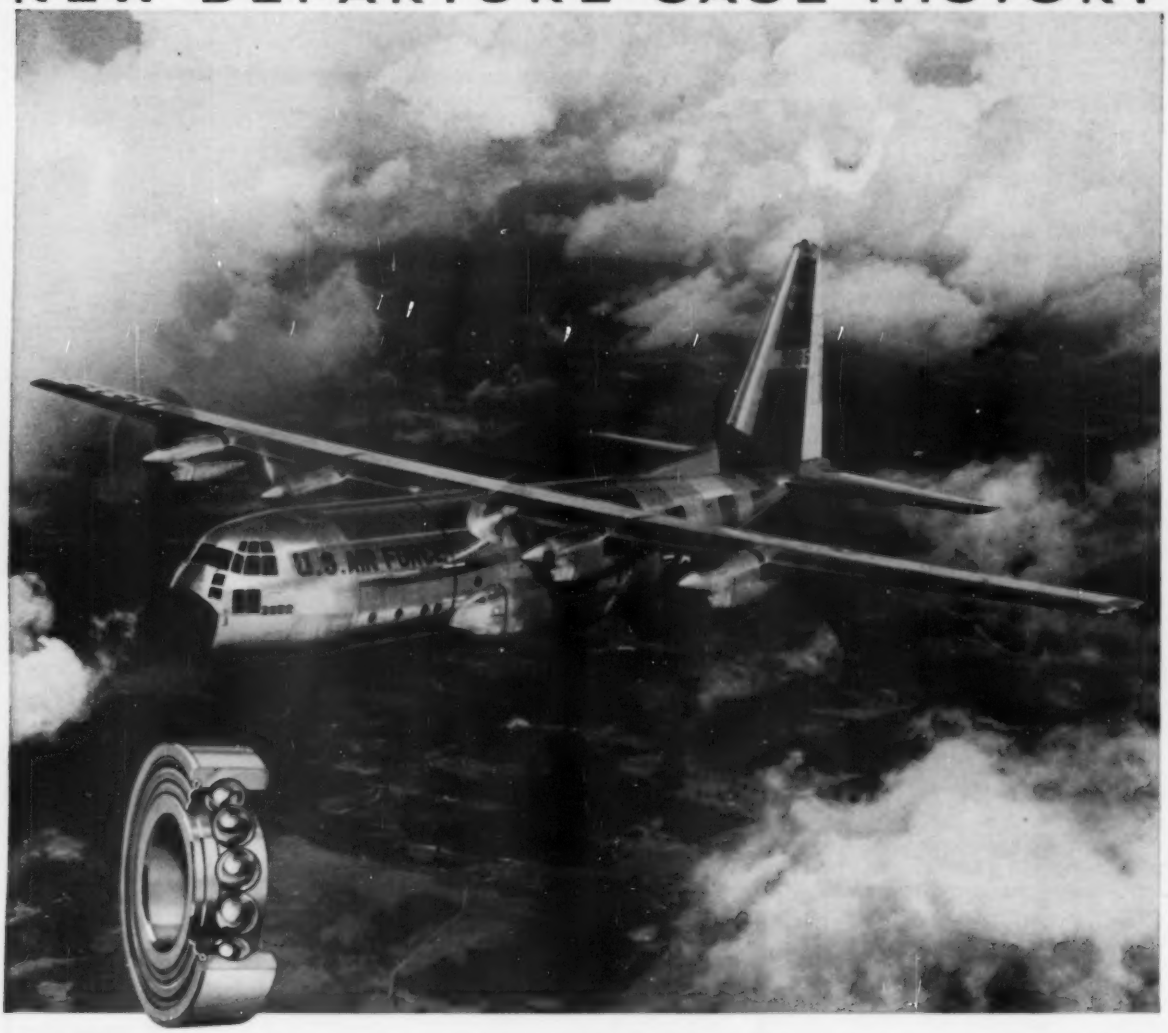

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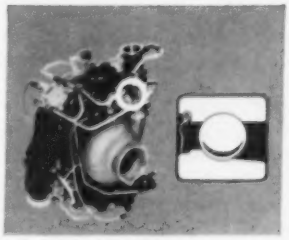

Photo: Courtesy Stratos Division, Fairchild Engine and Airplane Corp.

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of $79,972 in short-term loans and to finance the research and development (approximately $15,000) of new products, several of which are in the development stage; remainder (approximately $267,028) will be added to working capital.

Daystrom, Inc., Murray Hill, N. J., engaged primarily in the manufacture of electronic, electrical and electro-mechanical equipment and components having a variety of industrial, commercial and military applications; the company also manufactures certain consumer products. Offering is $10,000,000 of sinking fund debentures, due October, 1980, for public sale; offering price and underwriting terms to be supplied by amendment. Proceeds will be used to replenish and increase working capital. Initially, such proceeds will be applied to the repayment of short-term bank loans, which are incurred in part to finance increased inventories and receivables resulting from seasonal needs and expansion of the company's business, and in part to finance additions to plant and equipment; balance will be used for general corporate purposes, including the proposed expansion of the company's plant facilities at St. Joseph, Mich., and Worcester, Pa., and construction of a new plant in West Germany.

Dorsett Electronics Laboratories, Inc., Norman, Okla., engaged primarily in the design and manufacture of various electronic data handling and control systems; at present the company is principally engaged in the design and manufacture of airborne telemetering systems with special emphasis on missile instrumentation application. Recently acquired subsidiaries are engaged in the design and manufacture of various training and sales aids and films, industrial automation equipment and special electronic test equipment, and the manufacture of the Artisan Electronic Organs. Offering is 50,000 shares of common stock for public sale; offering price and underwriting terms to be supplied by amendment. Proceeds will be used to provide additional working capital, and reduction of debt which is currently based on pledged receivables; certain amounts will be supplied as working capital to subsidiaries to expand their operations.

Model Engineering & Manufacturing Corp., Huntington, Ind., engaged primarily in the manufacture and sale of electronics, precision mechanical and electro-mechanical products and equipment servicing principally the electrical, avionics, electronics, aircraft, missile and automotive industries. Offering is 140,000 shares of common capital stock; 130,000 shares for public sale. Public

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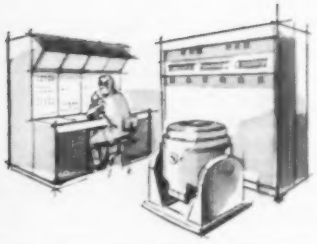

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offering price and underwriting terms to be supplied by amendment. Of the proceeds, $500,000 will be applied to reduce the $1,450,000 balance of a V loan; the balance for working capital.

In August, 1960, 5,000 of the company's common shares were issued and delivered to Montek, Inc., of Utah, in exchange for 102,525 shares of Montek's common stock, giving the company a majority holding of Montek's outstanding stock, subscribed for and reserved for conversion. The company's stock split of September, 1960, increased the stock holding of Montek to the additional shares included in the above offering. Such stock will be offered by Montek to all of its approximately 100 stockholders, other than the company, in exchange for their Montek stock.

The Lionel Corp., Irvington, N. J., engaged in the manufacture of model or toy electric trains and accessories, and electronic and electro-mechanical devices for government and industry. Also, the company has contracted to purchase the net assets of Anton-Imco Electronics Corp. whose principal assets consist of all the stock of Anton Electronics Laboratories, Inc., which makes electronic and nuclear detecting instruments (Brooklyn, N. Y.), and Intercontinental Manufacturing Company, Inc., which manufactures missile parts and air frame sections (Garland, Tex.). Offering is $4,500,000 of convertible subordinated debentures, due October, 1980, for subscription by common stockholders; record date, subscription price, interest rate and underwriting terms to be supplied by amendment. To the extent of $2,500,000, proceeds will be used to reduce existing bank loans (which include $1,300,000 paid for Anton-Imco stock); about $500,000 to expand the company's research and development program; the balance to provide additional working capital.

Metcom, Inc., Salem, Mass., organized under Delaware law in April, 1959, for the purpose of engaging in the production of existing types of microwave tubes and devices, the improvement of existing tube types and of the methods of producing tubes and devices, the development of new types of tubes and electronic devices and the undertaking of research and development programs for others. Offering is 100,000 shares of common stock for public sale; offering price and underwriting terms to be supplied by amendment. Of the proceeds, $41,600 will be used to retire a mortgage loan and $50,000 to purchase certain machinery and capital equipment now rented; $60,000 for the purchase of additional machinery and equipment; $100,000 for independent prototype development of a radiation detector; $150,000 for independent research and development in connection with the company's program for commercial production of Klystrons, magnetrons and microwave devices for use in products for the civilian consumer market; the balance for working capital.

Champion Spark Plug Co., Toledo, Ohio, engaged in the manufacture and sale of spark plugs for internal combustion engines. Offering is 750,000 outstanding shares of common stock for public sale by the present holders thereof. Initial public offering price will be related to the market price for outstanding shares at the time of the offering; terms supplied by amendment.

Chemtronic Corp., Nashville, Tenn., engaged in the development, manufacture and sale of miniature electrolytic capacitors. Offering is 200,000 shares of common stock, for public sale at $2 per share. Of the proceeds, $52,225 will be used to repay bank loans; $70,000, over a two year period, to add two engineers and one technician to the present research staff of the company; the balance for general corporate purposes.

National Aviation Corp., New York, N. Y., a closed-end non-diversified management company. Offering is 218,005 shares of capital stock for subscription

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by holders of outstanding common stock of record on Oct. 5, 1960, on the basis of one additional share for each four shares held; subscription price to be supplied by amendment. Proceeds will be added to the company's general funds and will be used in carrying out its investment policies.

ACR Electronics Corp., New York, N. Y., engaged in research, development and manufacture of high intensity lights, pulse transmitters, electronic devices, flashing lights and special photographic equipment, both for commercial uses and United States missile and other defense programs. Offering is 150,000 shares of common stock, 75,000 Series I common stock purchase warrants and 75,000 Series II common stock purchase warrants. These securities are to be offered in units, each consisting of two common shares and one five-year Series I warrant exercisable initially at $2 per share and one five-year Series II warrant exercisable initially at $2 per share; public offering price and underwriting terms to be supplied by amendment. Of the proceeds, about $35,000 will be expended during the next fiscal year to provide salaries for the additions to the personnel force; $45,000 for the liquidation of certain debts; $55,000 for machinery research and promotion; the balance to be added to working capital and used for general corporate purposes.

Vibration Mountings and Controls, Inc., Corona, N. Y., engaged in the manufacture and sale of vibration control and shock absorption devices for air conditioning, heating, industrial and defense applications. Offering is 150,000 shares of common stock for public sale at $3.50 per share. Of the proceeds, $175,000 will be used for the purchase of additional machinery and equipment for the manufacture of many of the components presently being purchased by the company from others; $30,000 for research and development of new types of vibration and shock control products; $35,000 for expansion of sales and promotional programs; $50,000 for the purchase of additional inventory; the balance for working capital and other corporate purposes.

Cannon Electric Co., Los Angeles, Calif., primarily engaged in the design and manufacture of electrical connectors and related wiring devices to provide multi-circuit electrical contacts for a wide variety of applications in the electronic, communications, aircraft, missile, computer, and other fields. Offering is 200,000 outstanding shares of common stock for public sale by the present holders thereof; offering price and underwriting terms to be supplied by amendment.

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Stock Transactions

The Securities and Exchange Commission's Summary of Security Transactions and Resultant Holdings for the period June 11 to July 10, 1960, reported the following transactions by four executives of Avco Corp.: disposition of 2,000 common shares by A. B. Newton, officer, leaving a holding of 5,666; disposition of 4,100 common shares by Henry J. Oechler, officer, leaving a holding of 1,000; acquisition of 2,650 common shares through exercise of option by Curry W. Stoup, officer, making a holding of 9,730; disposition of $45,000 of convertible subordinated debentures by Victor Emanuel, director, leaving a holding of $55,000.

Other transactions for the period June 11 to July 10 include:

Atlantic Research Corp. Disposition of 1,200 common shares by Gerald T. Halpin, officer, leaving a holding of 17,800.

Belock Instrument Corp. Disposition of 6,500 common shares by Harry D. Belock, officer and director, leaving a holding of 225,545; disposition of 2,000 common shares by Jack J. Fischer, officer and director, leaving a holding of 33,771; disposition of 1,000 common shares by Donald C. Walton, officer and director, leaving a holding of 18,171 (indirect holding remains 1,743).

Continential Air Lines. Disposition of 1,100 common shares by Lawrence C. Ames, director, leaving a holding of 9,400; disposition of 2,000 common shares by Louis H. Mueller, director, leaving a holding of 25,595; acquisition of $7,000 of 5½% convertible subordinated debentures by Lawrence C. Ames, director, making a holding of $17,000.

General Electric Co. Disposition of 1,400 common shares by F. J. Borch, officer, leaving a holding of 9,319; disposition of 600 common shares by George L. Haller, officer, leaving a holding of 100; acquisition of 6,890 common shares by Clarence H. Linder, officer, making a holding of 16,900; disposition of 1,729 common shares by Samuel Littlejohn, officer, leaving a holding of 4,211; acquisition of 2,500 common shares through exercise of option by H. A. MacKinnon, officer, making a holding of 9,827; disposition of 400 common shares by George F. Metcalf, officer, leaving a holding of 2,537 (indirect holding remains 242); disposition of 2,000 common shares by Jack S. Parker, officer, leaving a holding of 5,100; acquisition of 1,875 common shares through exercise of option by Harold F. Smiddy, officer, making a holding of 13,125; acquisition of 150 common shares as incentive compensation by Glenn H. Warren, officer, and disposition of 1,000 common shares, leaving a holding of 9,481.

Litton Industries, Inc. Disposition of 3,075 common shares by Norman H. Moore, officer, leaving a holding of 27,401; disposition of 100 common shares by Henry E. Singleton, officer, leaving a holding of 5,516.

Lockheed Aircraft Corp. Disposition of 1,900 capital shares by D. E. Browne, officer, leaving a holding of 5,397; disposition of 1,200 capital shares by A. Carl Kotchian, officer, leaving a holding of 432.

Loral Electronics Corp. Disposition of 16,600 common shares by Leon Alpert, officer, director and beneficial owner, leaving a holding of 125,800; disposition of 100 common shares by O. Arthur Koteen, officer, leaving a holding of 105.

Marquardt Corp. Disposition of 210 capital shares by Paul A. Holland, officer, leaving a holding of 284; acquisition of 1,400 capital shares by Donald K. Tasker, officer, making a holding of 1,400.

National Airlines, Inc. Disposition of 1,500 common shares by Daniel R. Topping, director, leaving a holding of 1,075.

North American Aviation, Inc. Acquisition of 2,250 common shares by John R. Moore, officer, making a holding of 2,358; acquisition of 200 common shares through exercise of option by W. H. Yahn, officer, making a holding of 300.

Northrop Corp. Disposition of 100 common shares by J. G. Nettleton, Jr., officer, leaving a holding of 224; disposition of 2,368 common shares, his total holding, by Richard R. Nolan, officer.

Northwest Airlines, Inc. Disposition of 700 common shares by Paul L. Benscoter, officer, leaving a holding of 200.

Pan American World Airways. Acquisition of 375 capital shares by Richard S. Mitchell, officer, making a holding of 2,547; disposition of 232 capital shares by Samuel F. Pryor, officer and director, leaving a holding of 15,000; disposition of 600 capital shares by John S. Woodbridge, officer, leaving a holding of 1,150.

Raytheon Co. Disposition of 472 common shares, his total holding, by N. B. Krim, officer; disposition of 500 common shares by W. E. Stevenson, officer, leaving a holding of 3,088.

Ryan Aeronautical Co. Disposition of 1,279 common shares, his total indirect holding through Jackson Investment Co., by Robert C. Jackson, officer and director (his indirect holding through Emtor, Inc. remains 329,100); disposition of 1,100 common shares by T. Claude Ryan, officer and director, leaving a holding of 106,047, and disposition of 1,100 common shares held indirectly through his wife, leaving a holding of 2,960 (indirect holdings through Emtor, Inc. remain 329,100); disposition of 1,250 common shares by G. C. Woodard, officer and director, leaving a holding of 360.

Temco Aircraft Corp. Acquisition of 4,100 common shares by Robert McCulloch, officer and director, making a holding of 47,659.

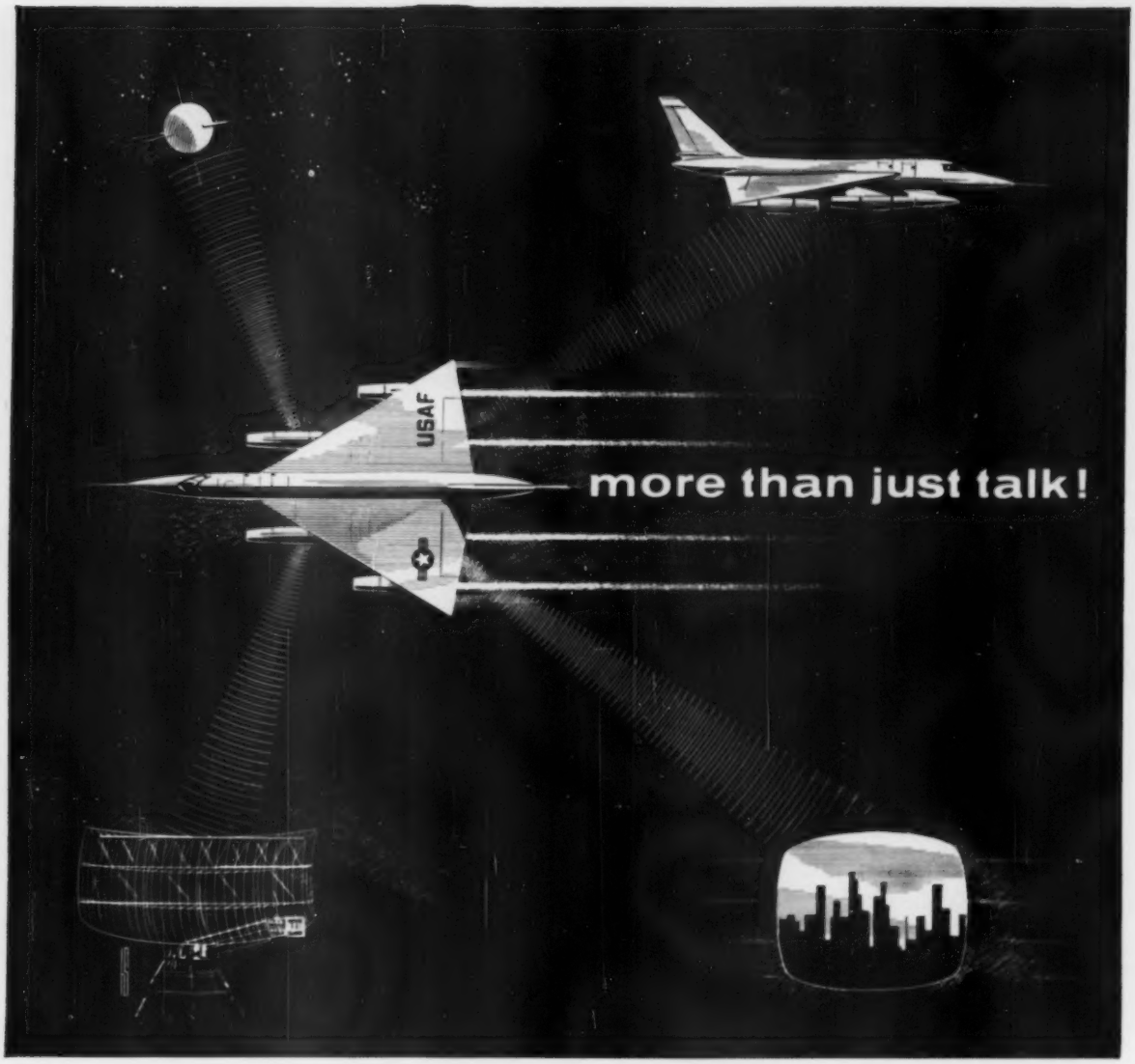
Thiokol Chemical Corp. Disposition of 500 common shares by Robert Lang, director, leaving a holding of 315,387; disposition of 1,000 common shares by Alfred Raws, Jr., officer, leaving a holding of 10,443.

United Air Lines. Acquisition of 100 common shares by Martin S. Ansorge, director, making a holding of 1,068; disposition of 200 common shares by S. P. Martin, officer, leaving a holding of 1,036; disposition of 100 common shares by Charles F. McErlean, officer, leaving a holding of 939.

United Electric Coal Companys. Acquisition of 4,100 common shares by General Dynamics Corp., the beneficial owner, making a total holding of 238,003 common shares.

Boeing Tests 502-10W Light Turbine

Boeing Airplane Co. has started 50 hr. cyclic tests on its 502-10W light turboshaft engine (AW Sept. 5, p. 31) as part of tests leading to Federal Aviation Agency certification. Engine shown here, one of the T50 series under development as aircraft, drone and helicopter powerplants, drives an 84-in. Hartzell three-bladed propeller. Engine weighs 325 lb., produces 270 hp. at normal continuous operation. This model has been revised to include new gear box designed for full-reversing action and a pneumatic governor to prevent prop overspeeds. Fuel range allows for use of diesel and jet fuels and unleaded gasoline (AW June 6, p 122).



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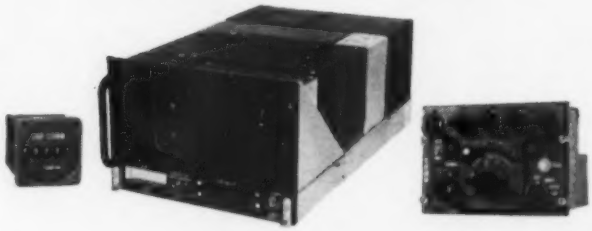
AN/ARC-50 SYSTEM



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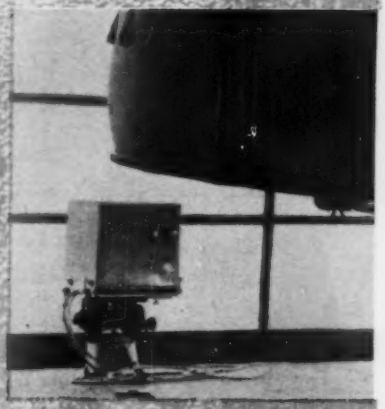

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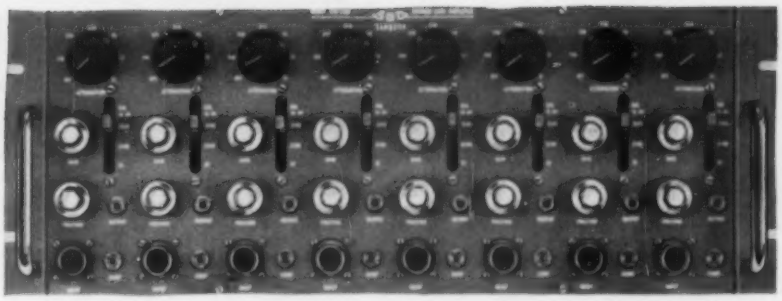

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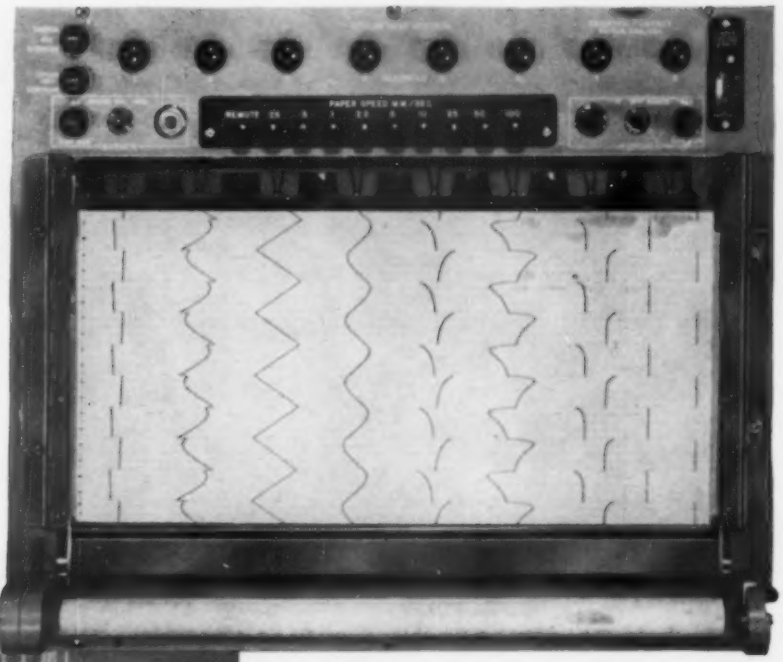

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...0 to 500 mv/div and 1 to 10 v/div	5 megohms each side balanced to ground	±2.5 v max. on most sensitive range, increasing to ±300 v on others	34 db on most sensitive range; 28 db on all other ranges	0-150 cps within 3 db at 10 div peak to peak	For Model 936 2900 ±2E input, single ended or balance inputs

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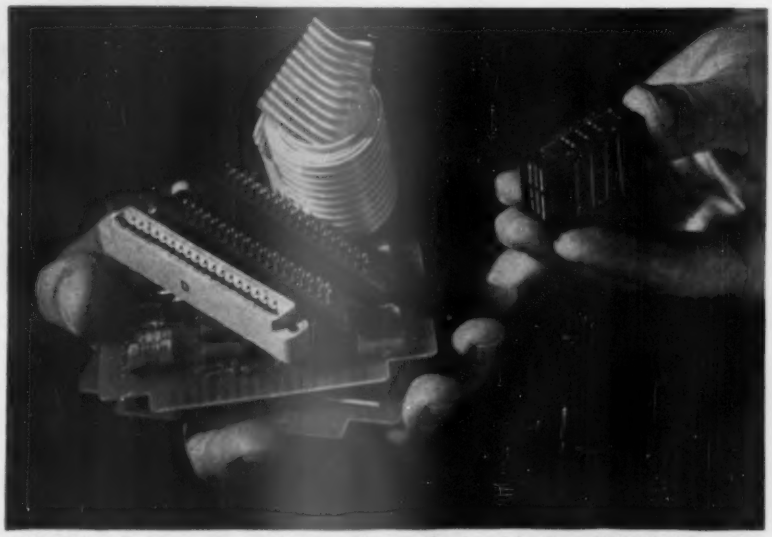
System Packaging Designed for Flexibility

By Barry Miller

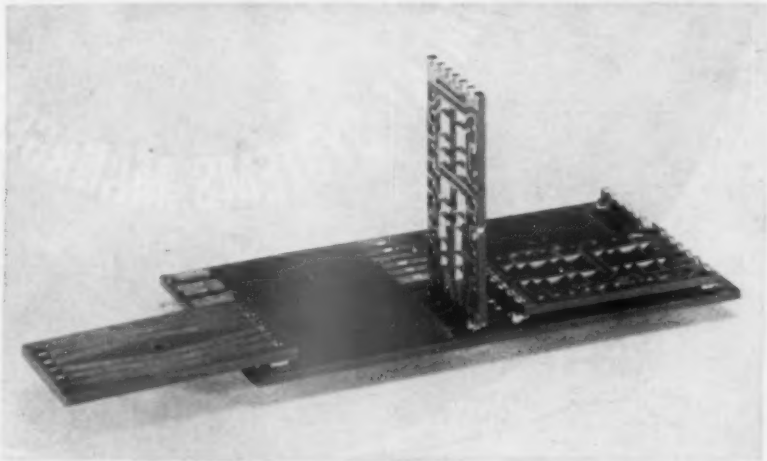
Canoga Park, Calif.—A fresh approach to microminiature avionic component packaging, which could go a long way toward resolving doubts of system design engineers about which way to proceed in a new field already crowded with many conflicting "approaches," was revealed here last week by the Ramo-Wooldridge Division of Thompson Ramo Wooldridge, Inc.

A paramount virtue of this microminiature scheme is that it is flexible. So flexible, in fact, that its circuit boards have but one fixed dimension (board depth), can be connected in any plane and in rather complicated patterns if desired. Connectors which join the circuit boards are single-piece, springy units that can be mounted on the four edges of the board and/or either face.

The connector serves as a shock absorber to cushion any jarring that an assembly might encounter in airborne or space applications.



FLEXIBLE micro component packaging technique developed by Ramo-Wooldridge employs Corning Fotoceram function boards with cavities for components etched into them. Function boards are connected by single-piece connectors to form compact subassembly (above next to equivalent-network circuit cards and necessary interconnecting hardware). Below is interconnecting board with function boards connected in several ways for demonstration.



Absence of Standards

The packaging approach is predicated on the continued absence of firm standards for micro components, although Ramo-Wooldridge engineers are active in the Subcommittee on Microminiature Components of the Electronics Industries Assn. and were instrumental in bringing about recommended component formats (AW Sept. 5, p. 90). It will house a variety of different sized and shaped discrete micro components, with or without leads, available on the the market or still in development laboratories. Housing of larger components such as chokes or large valued capacitors whose reduction to a size comparable to micro component formats poses thorny problems for component manufacturers can be handled. Also capable of being accommodated are functional circuits like Westinghouse's molectronic circuits and Texas Instruments' Solid Circuits which probably will be coming into vogue in the years ahead.

Particular attention in developing the Ramo-Wooldridge packaging approach was devoted to a novel scheme of interconnecting circuit boards so that space savings earned by shrinking components, pacing them close together, etc., are not squandered on large volumes for interconnections. Space consumed by interconnecting wires in micro circuitry schemes are frequently to blame for the deception in high component density figures computed on the basis not of system or assembly capacity but of how many components occupy a single substrate. Ramo-Wooldridge estimates that even with its approach, in which pains were taken to solve the interconnection problem, substrate component density is cut by a factor of four on the subassembly level. Thus, component density figures cited for the approach by Milton E. Mohr, vice president and general manager of the Ramo-Wooldridge Division, are one million components per cubic foot (based on substrate capacity) narrowed to ¼ million per cubic foot in the subassembly.

Essentially, the Ramo-Wooldridge approach utilizes Corning Fotoceram boards, 1/16 in. (62.5 mils) thick with holes in most cases corresponding to the shapes of components to be used etched completely through the board. Components mounted in a single board, or function wafer as they are called, are interconnected by etched wiring. This type of technique is referred to as cavity mounting and as such is simliar to the Mallory and Hughes packaging con-

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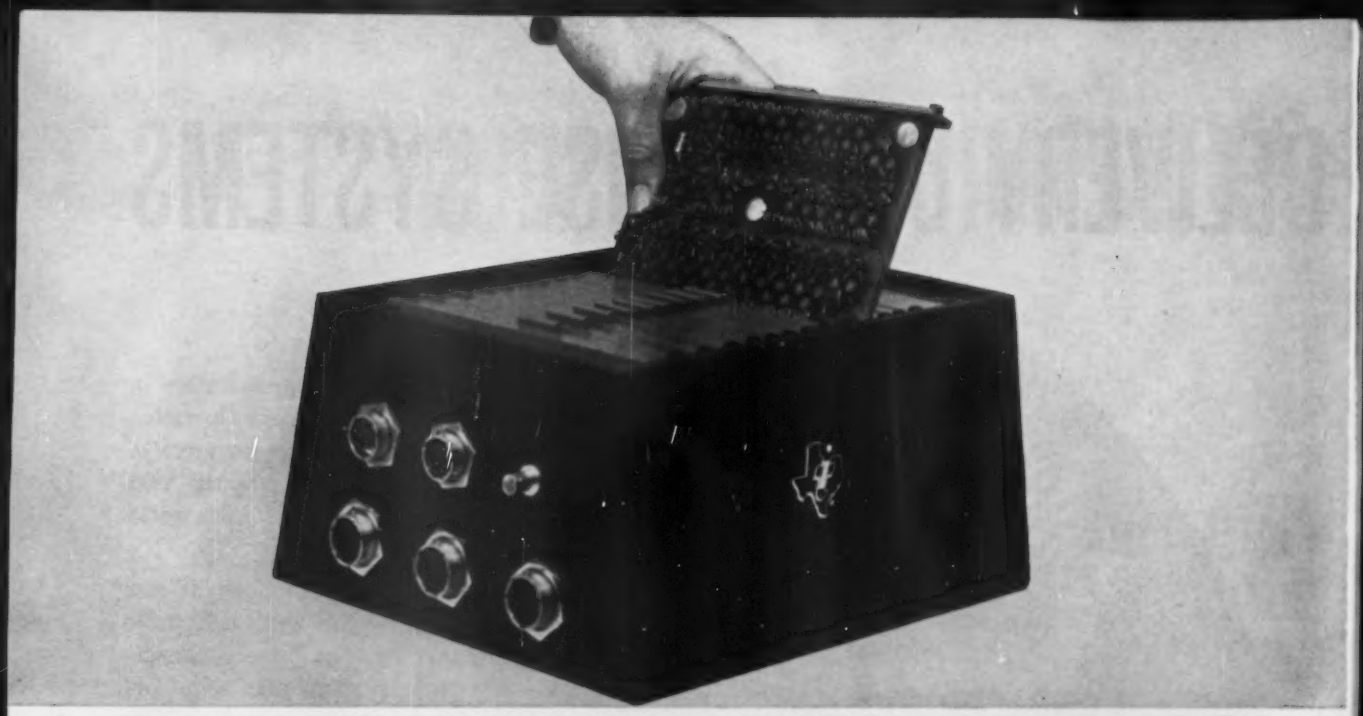

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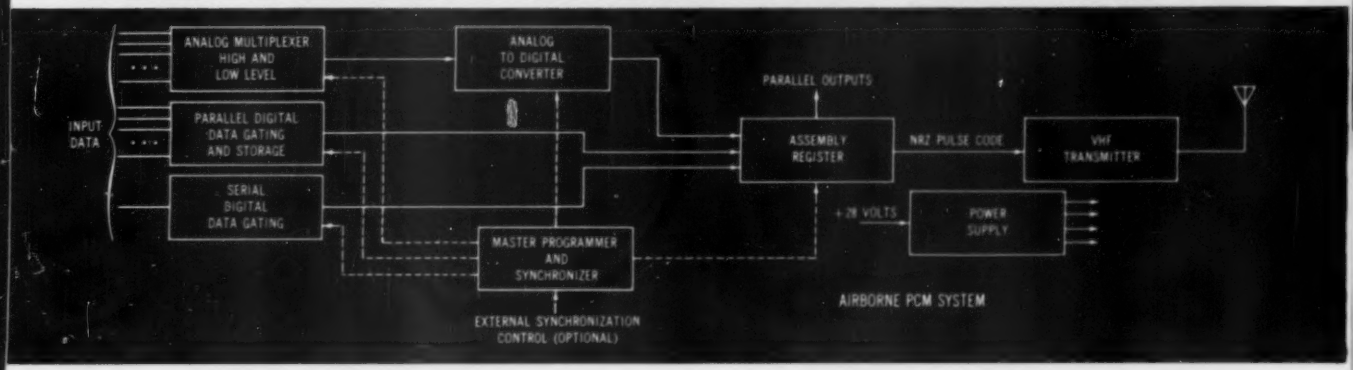

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A key feature of the system is its high-speed analog multiplexer which handles low- and high-level data, or a combination of both, with *only a single low-level amplifier*. Overall accuracy of the system is ±0.25% — made possible by a unique bi-directional servo loop that nulls out system drift. The system is packaged in individual modules so that it can be rapidly modified to fit the needs of other missiles or space vehicles.

PCM is only one of several advanced telemetry projects at Texas Instruments. Others include the development and/or production of analog systems and equipments for Bomarc, Corvus, Pershing, Minuteman, Titan, Centaur, and Project Mercury.

For detailed information about PCM telemetry or other TI missile electronic system capabilities, please contact SERVICE ENGINEERING:

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cepts (AW Oct. 24, p. 93). Each wafer may differ in size and will have differing hole patterns for different circuits.

The reason there is no optimum size board, Leonard Katzin, member of the technical staff responsible for the development explains, is that too much high component density advantage would be lost if the same function wafer were to be used for a 15-component as for a 40-component circuit.

For its program, the company hopes that all micro components will wind up with coplanar ribbon leads as the EIA subcommittee suggests and it is especially pleased, Katzin says, that 60 mils was set as the upper height limit for components with leads as this permits the component to fit snugly within the 62.5-mil-thick Ramo-Wooldridge wafer. Actually the scheme can accommodate either or a mix of lead and leadless components, although for assembly purposes one type might be preferred.

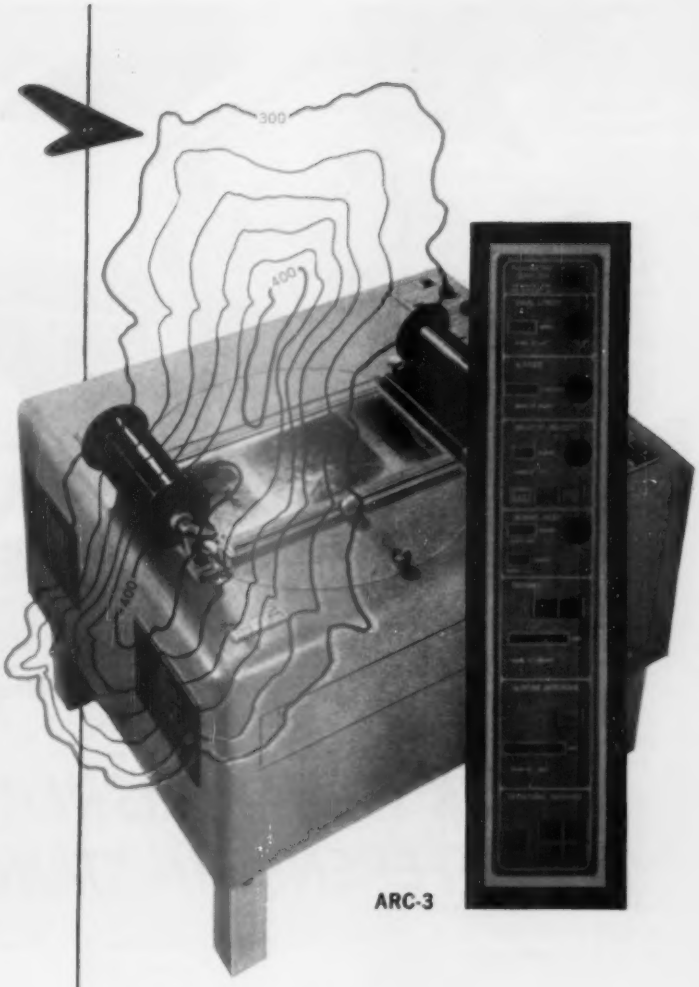
Ramo-Wooldridge wafers are interconnected directly or through transfer (interconnecting) boards, which may also have components in them. Connection is made by single piece connectors which have bifurcated contacts. Use of connectors side-steps what might be a problem in ceramic-to-ceramic joints between boards.

The connectors can be inserted along the edge of a wafer to permit connection of that wafer normal to the transfer board. Or they may be placed into the wafer for paralleling wafers or wafers and transfer boards. Single piece connectors effectively shorten conducting path between components and do away with the need for the chain of connector-receptacle-solder connection, etc., between boards which is often a source of failure. Shorter conductor paths are important for projected high speed circuits of computers (Ramo-Wooldridge's business). Such high speeds are envisioned with devices like tunnel diodes and phase locked oscillators that the signal delay time between components becomes appreciable relative to the actual device switching time.

At present, Katzin says, spacing between wafers is the same as the thickness of the wafers, namely 62.5 mils.

Components developed for the Army-RCA Micromodule program and mounted within the 310-mil-square alumina wafer can simply be cemented on top of the Ramo-Wooldridge function wafer. Should the 62.5-mil spacing between function wafers be inadequate for clearance, a hole or holes can be etched through the top function wafer. Some very small micro components, such as Pacific Semiconductors' micro transistors, can be placed side by side in a single hole.

Besides the design flexibility, simple



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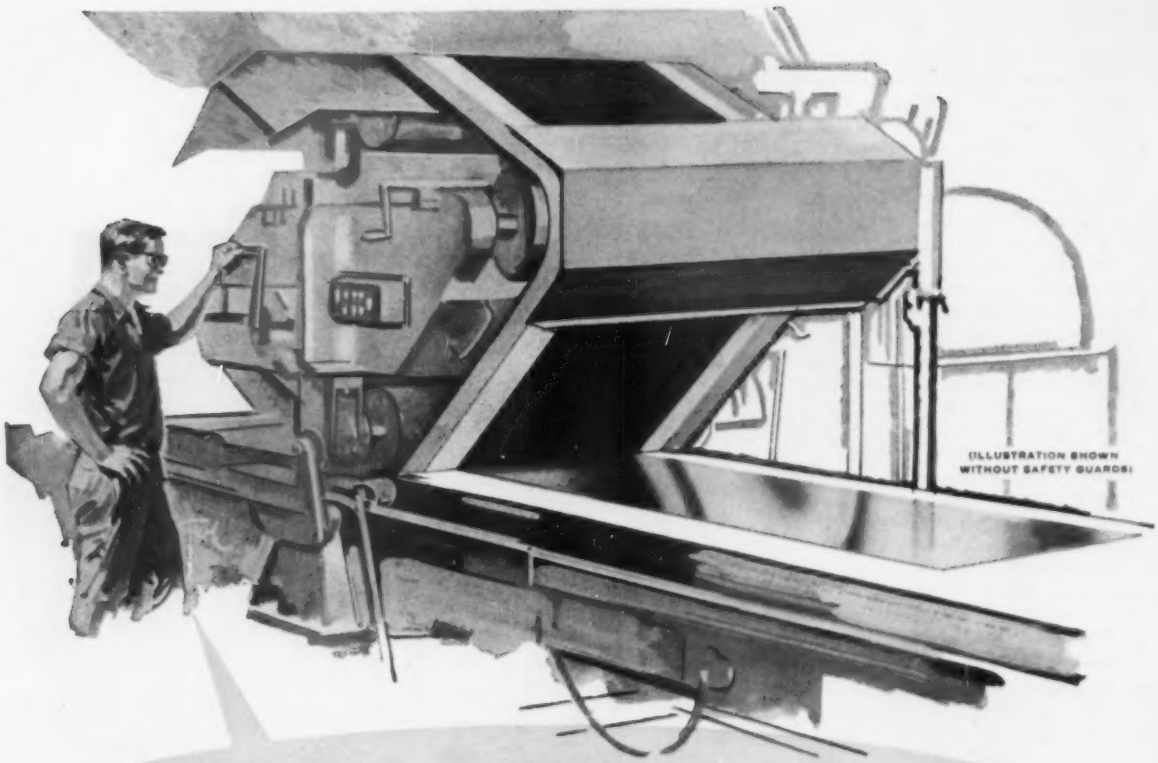

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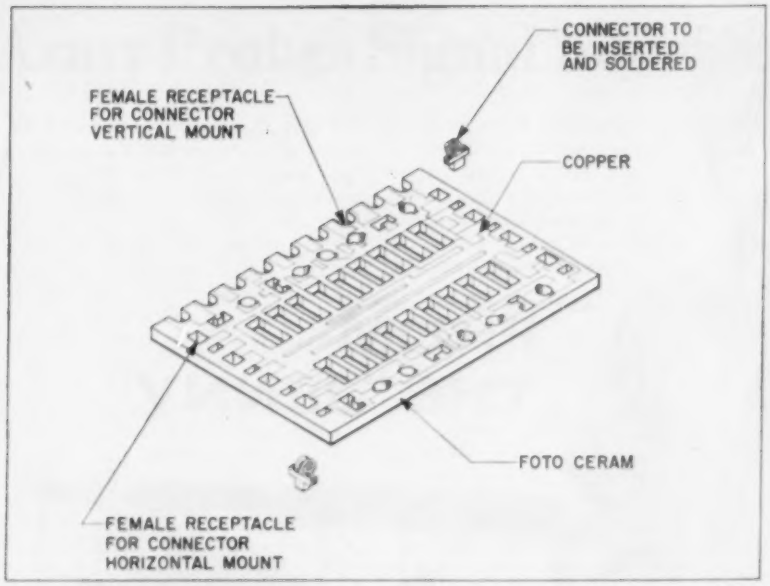

CONNECTOR TO BE INSERTED AND SOLDERED
FEMALE RECEPTACLE FOR CONNECTOR VERTICAL MOUNT
COPPER
FOTO CERAM
FEMALE RECEPTACLE FOR CONNECTOR HORIZONTAL MOUNT

FUNCTION BOARD has holes for given shaped components pre-etched into it on basis of pattern prepared by designer. Note that board is its own receptacle for the connector.

and short interconnections between wafers or components on different wafers, and the diminution in size of assemblies, other advantages cited for the technique by Mohr and Katzin are:

• **Maintainability**—Circuits can be serviced down to the component level and individual wafers can be removed from the structure with a simple tool similar to a dental pick. Test points are readily available.

• **Environmental resistance**—Heat dissipation is comparable to that obtained with radiation fins. Each board has a natural convection path. Fotoceram boards possess high thermal conductivity (2.06 Btu./hr./sq. ft./deg. F/ft. compared with 0.17 for laminates).

Cost of an assembly using this approach would be about 1¼ times that of conventional printed circuit cards. Density for such assemblies would be about 80 lb./cu. ft.

Function wafers are prepared as follows: At Corning a photosensitive glass is covered by a negative with the desired circuit pattern prepared by Ramo-Wooldridge and exposed to light. This selectively changes the composition of the exposed portions of the glass to develop a 20/1 etching differential. Cavities are then etched into a wafer by placing it in a hydrofluoride bath. Wafers are then sintered into a ceramic and forwarded to Ramo-Wooldridge. Here they are coated with an electroless copper. At this point, the wafers are handled in one of two processes.

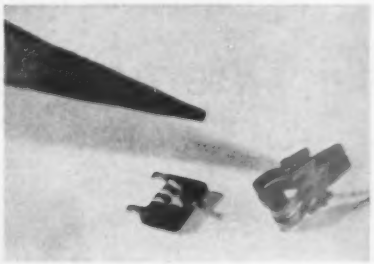
In the first, an additive process, portions of the wafer where no circuit is desired are masked and the wafer exposed to an electroplating process which builds up a heavy copper coating over it. A gold flash which acts as a resist during a subsequent etching process is then added to the electroplated areas. In the subtractive process the desired areas are masked off and the remaining areas are etched away.

Fotoceram was selected for this application, according to Katzin, because it is a homogeneous material, thus does not absorb water, has a high natural frequency, is ¼ the cost of laminates, can withstand high temperatures and has high thermal conductivity.

Gold-plated leads or edges of components are connected to the wafer by simply touching an iron to them.

Connectors evolved from about 10 trial designs are now being made for the assembly. They meet MIL C 8384, contact resistance No. 26. The connectors are placed in respective holes and boards mated before soldering so that each wafer acts as its own jig.

The connectors are made from a pattern, about 20 times actual size, which is photo reduced, stepped and repeated to produce a long pattern of about 50 identical designs, much like a string of paper dolls. With the pattern superimposed, sheet stock is photosensitized, etched from both sides, individual patterns are separated and then formed in a tool to make the connectors. Heat treating for spring characteristics and gold plating follows.



SINGLE-PIECE connector, key link in flexibility of micro component packaging, is shown next to Pacific Semiconductors, Inc., micro transistor.

Ramo-Wooldridge says it has already invested over $100,000 of its own funds in this program and expects to continue its support of it, company spokesmen said. Katzin and H. E. Mendoza, who heads the Equipment Development section of the Digital Computer Department, say they hope to build a 24-bit register employing the technique in the near future.

Apparently, Ramo-Wooldridge has not encountered any dearth in components to use with its program. Micro transistors and micro diodes manufactured by Thompson Ramo's subsidiary, Pacific Semiconductors, and micro transistors conforming to the EIA Subcommittee recommended formats made by Transitron Electronic Corp. are among those used. Mallory tantalum pellet capacitors (AW Oct. 24, p. 93 and Sept. 5, p. 90) will be purchased. Other interesting micro components and companies supplying them are:

• **Ceramic resistors**—Leadless ceramic film resistors in values from 5 ohms to 1 megohm produced on strips of aluminum oxide 100 mils long, 62 mils wide and 62 mils thick, are supplied by Microlectron, Inc., 1547 18th St., in nearby Santa Monica. Resistors are rated at 0.1 watt, have temperature coefficients of 200 parts/million ±10. Resistors are made from a complex ceramic ink which can be printed in place to predictable values and made in ohms/square values from 2 to 1,500 ohms per square. Ohms per square values are altered by changing ceramic formulation leaving essential properties untouched.

• **Barium titanate capacitors**—Capacitors with leads made of barium titanate, measuring 80 x 80 x 50 mils and in values up to 2,000 picofarads are obtained from what is now a new department of Gulton Industries, formerly the Electronics Department of the Mullenbach Division of Electric Machinery Manufacturing Co. Temporary address is 2100 East 27th St., Los Angeles 58, Calif.

• **Metal film resistors**—Two types of metal film micro resistors, with and without leads, in values from 200 ohms to 100,000 ohms plus or minus 1% 0.1 watt dissipation, are obtained from International Resistance Co., Philadelphia. Resistors with leads are 105 mils long, without leads 120 mils long. Diameter of leadless unit is 62 mils, with leads, 41 mils. ◆◆

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Army Probes Signal Interference Problem

Ft. Huachuca, Ariz.—Insight into the sources and possible remedies for interference among military electronic gear may be acquired from equipment tests conducted under simulated battle conditions at a unique $90 million electromagnetic environmental test facility (AW Jan. 4, p. 15) being erected and instrumented over an area of thousands of square miles in southern Arizona.

One terminus and effective center for the facility will be the Army's electronic proving ground, situated among the Huachuca, Santa Rita and Dragoon mountains in southeastern Arizona about 80 highway miles (45 air miles) southeast of Tucson and about 65 road miles northeast of the Mexican border at Nogales. What is now the six-year-old electronic proving ground roughly 80 years ago was a desolate military outpost from which the U. S. Army cavalry exercised itself against itinerant Apache Indian bands. Aside from a few widely scattered metropolitan areas such as Tucson, southern Arizona has changed little from its Indian frontier days. It is still a thinly populated, austere spot dotted as far as the eye can see with scraggly mesquite and tumbleweed. Yet it is this sparsely populated character, the isolation and mixed rugged and flat terrain which combine to make the area an attractive location for the nation's, and what the Army says will be the world's, only electronic environmental test facility of its type.

Test Objectives

Here the Army plans to test all types of electronic gear under simulated battle conditions in desert and mountainous terrain away from interfering radio signals found in more heavily populated areas. These tests, it believes, should:

- **Reveal which equipments** or systems produce excessive interference with one another and which are incompatible.
- **Suggest possible changes** in its present equipment needed to minimize or eliminate interference.
- **Provide a basis** for setting standards for new military electronic equipment and allocating frequencies for this equipment.

The need for such a facility can be appreciated, according to the Army Signal Corps Lt. Col. G. E. Redheffer, when one realizes that should the Army go to war today it would have three times the number of electronic transmitters that it had at the end of World War II for a given combat area. Many of these operate at higher power levels than older equipment and the effect of 75,000 electronic radiators switched on in a 100-mi. square combat area might create a form of intelligence chaos. Add to this the emission contributions of avionic gear of USAF and Navy interceptors and bombers which can be expected in the combat area and the need for precise control of electromagnetic radiation can be surmised.

Service Cooperation

While the EETF (Electromagnetic Environmental Test Facility) slated for final completion in 1965 is an Army project, other services are expected to share its results and presumably eventually its use. Other services are now cooperating with the Army in the venture. A Marine Corps liaison will soon be stationed at Ft. Huachuca and USAF interceptors from Holloman AFB, 300 mi. to the east in southern New Mexico, have flown and will continue to fly chase for and provide a backup for recovery of Army test reconnaissance drones. Prime contractor to the Army and responsible for the engineering, installation and operation of the facility is Pan American World Airways. The company has an $18.8 million two-year contract. Remaining portions of the estimated $90 million cost of the facility will be incrementally funded throughout the projected five-year setup period. Bell Aerosystems is a major subcontractor.

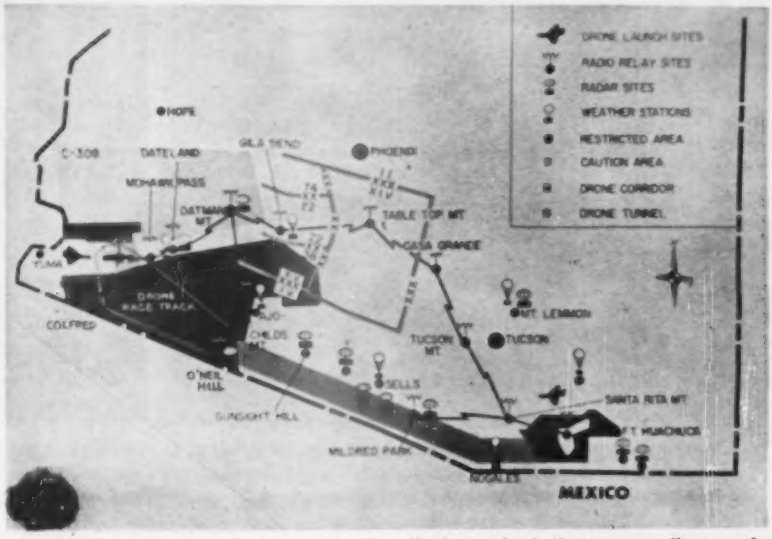
The test facility will consist essentially of three parts—an electromagnetic environmental area, a complete drone test facility, and a common test facility. The entire EETF will sprawl from Ft. Huachuca westward about 250 mi. to Yuma, north and west to the Gila Bend area below Phoenix. The Mexican-United States border will rim the facility on the south. Only isolated spots and areas where it intends to erect communications, radar, or instrumentation gear will be "occupied" by the Army. Grazing and entry rights will be retained by legal owners and/or ranchers, Col. Redheffer says.

The EETF fuses a laboratory of controlled environment and the actual field conditions under which a modern army might use its complex of electronic gear. The laboratory in this case will be outdoors but fully instrumented and monitored so that reproducible conditions can be obtained.

Three Parts

Function and make-up of each of the three parts of EETF are as follows:

- **Electromagnetic Environmental Test Area**—The Electromagnetic Environmental Test Area is now being instrumented in the Gila Bend Region by Bell Aerosystems. First testing on a military company level began in July. Here about 45 technicians and engineers operate such electronic equipment as walkie and handie talkies and Jeep-mounted field radio transmitters that an Army company might be expected to employ in battle group conditions. Extraneous radiators such as gasoline engines and electric motors run simul-



ARMY'S Electromagnetic Environmental Test Facility to be built incrementally over the next 4½ years will consist of a drone test facility, an electromagnetic environmental area, and a common test facility as shown (not to scale) on this map of southern Arizona. Facility is expected to lead to remedies for mutual interference created by large numbers of high-powered electronic equipments used by a modern army.

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taneously. Interference is determined by psycho-acoustic tests and phonetic balancing of transmitted words with pre-recorded words. Equipment pinpointed as source of interference is removed to the laboratory and is examined there.

In March, facility instrumentation will be expanded to accommodate a battlegroup within the environment of a division; at the end of 24 months this will be enlarged to encompass a division in the environment of a corps. Thus, step by step, Bell under Army supervision will extend the area until at the end of five years the Army can test the communication electronic equipment of an entire corps including its airborne equipment within the environment of a field army. Ultimately the monitoring will be automated, with the initiation of radiation, signal pick-up and matching of recorded signals with proper phonetic standards completely controlled. Realistic conditions will be followed in all respects.

Battlegroup equipment will be programed on and off by punched IBM cards. Test data will be reduced at the proving ground's automatic data processing department. Then a mathematical model can be synthesized from gathered data and refined continually by subsequent test data until its predictions repeatedly correspond with test results. It will predict where interference is likely for a given battle condition and will extrapolate from test results to predict results in terrains, environments and deployments which cannot be reproduced here in southern Arizona, according to Col. Redheffer.

• **Drone Test Facility**—This area includes a launch, control and recovery area, a drone "racetrack" area near Yuma test station and a drone test corridor, approximately 40 mi. in width and extending about 250 mi. in length from the Yuma station eastward to Ft. Huachuca. Function of this facility is to evaluate advanced airborne combat surveillance systems. The corridor provides entrance to and exit from the environmental area so that avionic systems too will be evaluated under actual field conditions.

Launch facilities for Republic AN/USD-4 and Fairchild AN/USD-5 drones are situated near Yuma. When the drone corridor is completed, it will permit evaluation of guidance, sensors and high altitude capability of surveillance drones and of terrain avoidance radars for drones flying at less than 500 ft.

Corridor equipment now includes an RCA AN/FPS 16 and an AN/MPS 25 radar. By completion date, an AN/MPQ 12 radar will be situated near Yuma and two, or possibly four AN/MPS 26 radars will be added. Bids for a line-of-sight microwave communications link are being evaluated now by Pan American, while another microwave link, this one composed of Collins Radio equipment, is in operation now at Yuma. Three or four telemetry sites are contemplated. Telemetrics, Inc., count-down clocks will be employed at all sites and new timing standards will be used.

Although the Army won its military campaigns against the original inhabitants of Arizona, it has not been as fortunate in its legal sparring with the present Indian residents in regard to the test facility. The Papago Indians have refused the Army access to a choice radar location situated on their reservation and as a consequence the Army has had to settle for an alternate site.

• **Common Test Facility**—This will be located at Ft. Huachuca and will share many equipments currently used as part of the proving grounds' other operations. Facility equipment will include a frequency monitoring station, communications and data transmission, antenna test range and an electromagnetic test range.

Meteorological data will be supplied by the proving ground's meteorology department and the U. S. Weather Bureau.

Presently, a number of advanced equipments are undergoing evaluation

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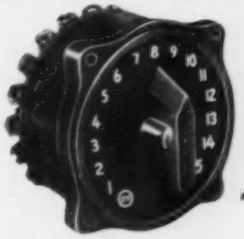

Flanged Cases in 2 inch 3 inch 4 inch dia.

Engineered to give years of service in test work as well as in permanent installations, LEWIS switches have heavy, low-resistance contacts; positive detent action and sturdy terminals for easy wiring.

The cases are splash proof and dust tight, of close fitting bakelite. Husky black-finished aluminum indexing knobs are used to turn the stainless steel shaft supporting the rotating brushes.

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here, though not as part of the EETF. These include Fairchild Camera and Instrument's photo-transmission system (AW Feb. 22, p. 69) which is able to take photos from a drone, scan them, transmit signals back to a ground station where they are reconstituted within minutes. A somewhat similar Hallamore TV transmission is also being evaluated.

Motorola's side-looking radar, which is capable of providing moving target indications of any object traveling at a speed of greater than one mile an hour, is undergoing flight tests. This radar is a separate development from the Signal Corps' Project Michigan-Texas Instruments high resolution mapping radar (AW Apr. 18, p. 94).

FILTER CENTER

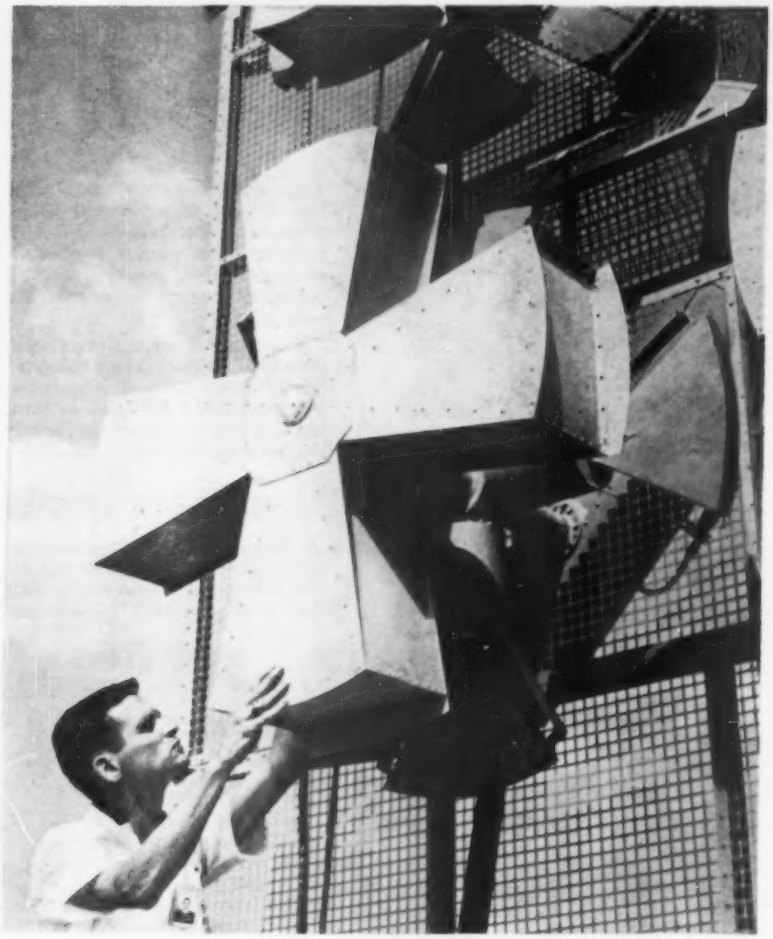
▶**Latest Transistor Sales Reported**—Semiconductor manufacturers sold 9.7 million transistors in August, an increase of 36% over the same month in 1959 but smaller than August, 1959's 69% increase over August, 1958. Dollar volume in August was $22.7 million, an increase of 26% over the same month in 1959, but also down from the August, 1959, gain of 81% over August, 1958. Total unit sales for the first eight months of this year were 77.3 million, an increase of about 58% over the previous year. Total dollar sales were $193.8 million, an increase of 45% over the same period in 1959. Figures were released by Electronic Industries Assn.

▶**New Technique Reduces Message Errors**—Technique for maximizing the amount of binary data transmitted over a channel while minimizing the possibility of error by automatically varying the number of parity check digits used as a function of channel noise, has been developed by New York University scientists under sponsorship of Air Force Cambridge Research Laboratories. By means of feedback from receiving station to transmitting station, the percentage of the message devoted to parity check digits, and hence the effective data transmission rate, is automatically adjusted to achieve desired error rate. Change in channel signal-to-noise ratio automatically results in change in effective data rate.

▶**GE to Build Solar Power Facility**—General Electric's Missile and Space Vehicle Department will build facility for testing static solar-power generation systems in Phoenix, Ariz. Facility will include solar collectors as large as 21 ft. in diameter for testing thermionic and regenerative fuel cell power generation systems. Collectors will be installed on radar antenna mounts so they can be continuously oriented toward the sun.

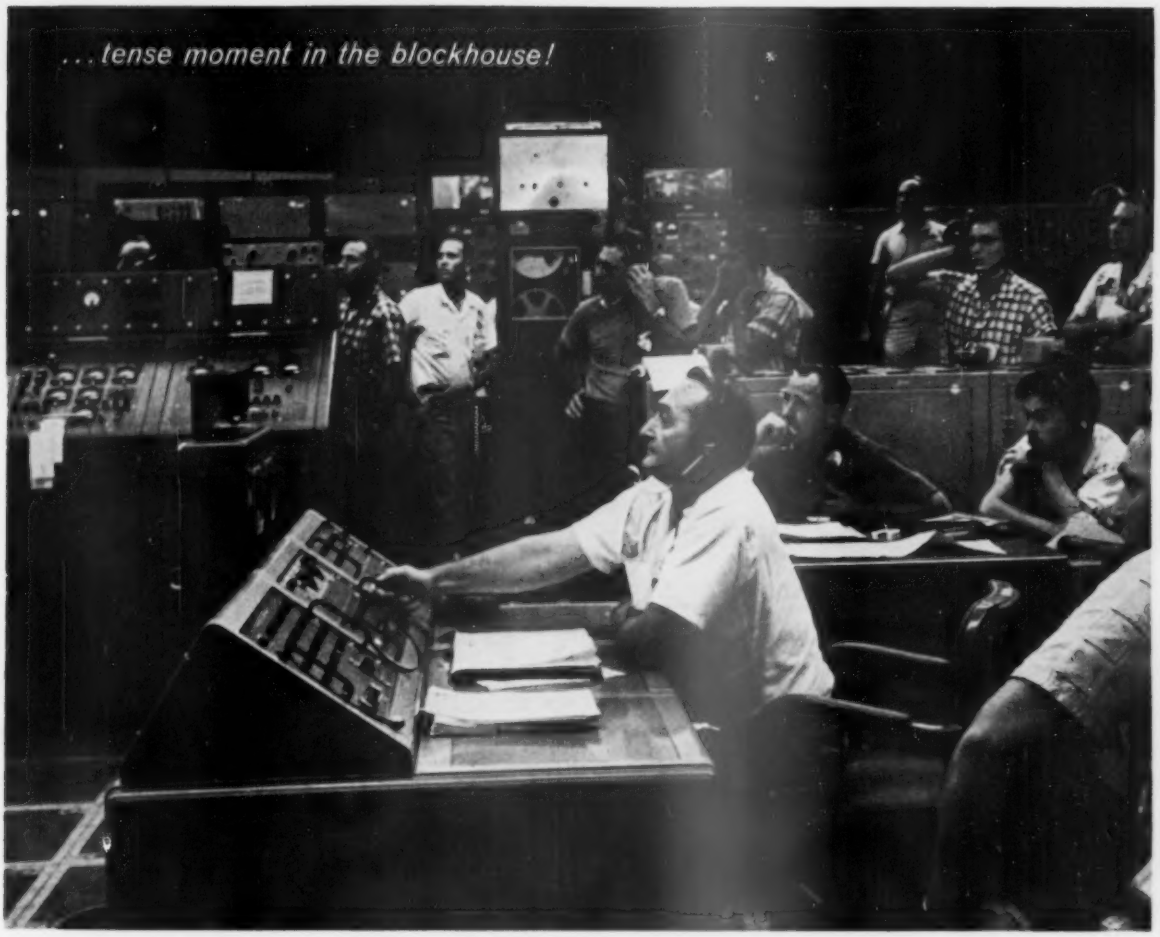
▶**Arinc Issues Transistor Manual**—Engineers who design avionic equipment for the airline market will want to order copy of new specification issued by Aeronautical Radio, Inc., entitled "Selection and Application of Semiconductor Devices." The report, identified as Arinc Spec. No. 409, is intended to provide guidance to designers in their choice of semiconductor devices for airline equipment and to semiconductor manufacturers who want to produce devices for the airline market. Copies can be obtained for $1.00 by writing Arinc, 1700 "K" St. N. W., Washington 6, D. C.

▶**Epitaxial Transistors Now Available**—Motorola and Sylvania report that they are now in production on epitaxial transistors. Motorola's Type 2N834 is a silicon mesa capable of delivering ½-watt power with 10-db. gain at 70 mc., company says. Breakdown voltage is approximately 90 v. and storage time is as low as 12 nanoseconds, company says. Price is $18.00 in quantities of 100 or more. Sylvania's epitaxial transistors are germanium diffused base mesa types, SYL2300 and SYL2301. These are electrically similar to conventional mesa Types 2N702 and 2N711, but have improved performance in saturation voltage and switching time. Sylvania says it has already developed experi-



Chance Vought Designs Versatile Antenna

Multi-polarized antenna has been developed by the Electronics Division of Chance Vought Aircraft, Inc., Dallas, Tex., for installation on USNS Range Tracker, the Pacific Missile Range's first tracking vessel, which is currently being instrumented by the company's Range Systems Division. Novel design of the antenna permits rapid operation to any of four antenna functions: vertically or horizontally polarized and clockwise and counter-clockwise helical configuration. Polarization can be selected by remote switching or automatically providing instant response. Previously it has been necessary to "shut down" an antenna to change its element to accommodate a particular missile or space vehicle program, the company notes. Cost is no greater than that of standard designs not offering this versatility.



Kinetics Voltage Sensing Relay helps test conductor get the answer "All systems GO!"

The Kinetics Voltage Sensing Relay with all-solid-state voltage sensing circuit.

In operational command control centers for launching the Atlas missile, Kinetics Voltage Sensing Relays provide vital "go – no go" information to the test conductor. The voltage sensing circuit is a completely solid-state device that can provide continuous monitoring of any a-c or d-c missile voltage.

Typical voltages to be monitored are telemetering signal levels, inverter outputs, batteries, and similar important voltages. Relays may be supplied that will trip only on low voltage or on low and high voltage, with both "set" and "reset" actions, as desired. Output from the 2-pole, double-throw relay contacts may be used to start small motors, blow horns, operate lights or larger relays.

A high input impedance may be presented to the signal source to limit current requirements. Available either with limit voltages that may be externally adjusted within the desired range or with pre-set voltages to the customer's requirements. A resolution of $\pm\frac{1}{2}$ volt is typical.

The Kinetics Voltage Sensing Relay is ideal for missile launching ground support equipment. However, it is also small, lightweight and rugged enough for airborne applications. Write or phone today for more information. Kinetics Corporation, Dept. KA-11, 410 South Cedros Avenue, Solana Beach, Calif. SKyline 5-1181.

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Professional placement report
for Electronics Engineers

How the continuous need to improve the nation's space surveillance capabilities opens avenues for new engineering careers

The continuous need we are talking about at General Electric refers to the fact that future-generation missiles, satellites and deep space probes will require refined or entirely new detection techniques, including many that have not yet been conceived.

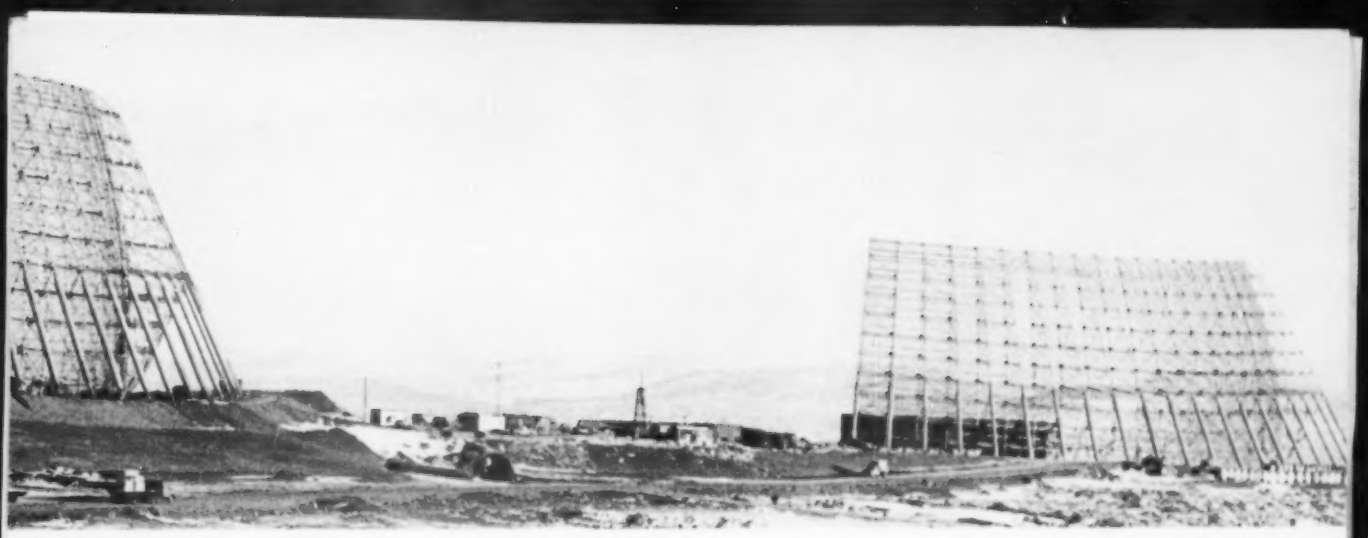
For example, it is anticipated that for every technical discipline now utilized in the detection field, at least one more must be found to apply within the next 10-year period.

With this in mind, General Electric is increasing its electronics engineering staff now working on advanced missile, satellite and deep-space-probe detection systems. Keeping pace with this expansion, the Company added a new building last year, and another will be ready for occupancy in a few months.

First clues to this trend were obvious in General Electric's well known "Golfball Study," published five years ago. This study compared the problem of missile detection to that of locating a golfball 200 miles away, using the most advanced techniques available in 1954. The problem no longer has such proportions, thanks to the creative imagination of dedicated General Electric engineering, scientific, and technical personnel responsible for designing and developing the unique surveillance sub-system of the Ballistic Missiles Early Warning System (BMEWS) which is receiving headline attention today.

Find out more about these creative and self-expressive opportunities now open to qualified personnel in one of the most vital technologies of the space age.

GENERAL ELECTRIC



Immediate openings for qualified electronics engineers

RADAR EQUIPMENT SYSTEMS SPECIALISTS capable of conceiving and directing the design of long-range radar systems. Desirable experience includes 3 to 10 years in at least one of the following: radar systems design, antenna systems, RF components, transmitters, radar receiver systems or radar data processing systems. Salary structure is fully equal to the professional requirements of the job.

ADVANCED SYSTEMS ENGINEERS capable of defining future defense and space detection problems including deep space-probe tracking. Also the ability to conceive and establish the feasibility of optimum systems solutions to these problems—making use of the most advanced techniques and understandings. Also required is an ability to recognize the need for, and coordinate the development of, new techniques and the exploration of new phenomena. Experience requirements include a Bachelor degree plus a combination of advanced training and several years' experience in both the theoretical and practical aspects of detection systems engineering. A desire to work in the conceptual phase of systems design with the analytical ability required to evaluate and demonstrate the effectiveness of the proposed systems is essential.

FIELD OPERATIONS ENGINEERS for systems management teams to be deployed at complex radar systems installations of the BMEWS type. Systems-oriented Electronics Engineers are needed who have the ability to assume responsibility for installation, checkout, and integration of major radar systems. Background in high-powered Klystron transmitters, low-noise receivers and digital data processing equipment is desirable. A Bachelor degree is required.

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GENERAL ELECTRIC

mental silicon epitaxial transistors which resemble the 2N696 and 2N697 family. At temperature of 25C, these units have displayed saturation voltages as low as 0.02 v. and storage time as low as 30 nanoseconds with 150 ma. collector current, company says.

▶ **SAC Gets Faster Weather Computer**—Strategic Air Command has taken delivery of a new IBM 7090 computer, installed at SAC Headquarters near Omaha, which is expected to produce 24 and 36-hr. wind and pressure forecasts for five altitude levels up to 55,000 ft. in 20 min., considerably faster than the IBM 704 previously used for the task. Computer will also enable Air Weather Service meteorologists to make detailed forecasts and climatological studies never before possible, SAC says.

▶ **Signed on the Dotted Line**—Major contract awards recently announced by avionics manufacturers include:

• **Avien, Inc.,** Woodside, N. Y., will build new type of modular antenna system for Air Force unmanned missile/satellite tracking station, and similar antenna for Signal Corps under contracts totaling about $100,000. Work will be carried out by company's newly-formed Antenna Department, headed by Richard D. Bogner who invented the new modular antenna.

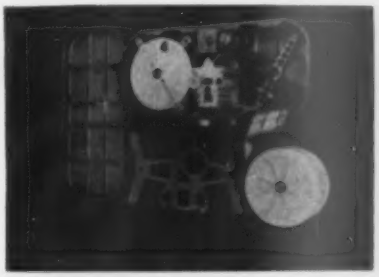
• **Sanders Associates,** Nashua, N. H., $1.1 million contract from Bendix Corp. for production design phase in development of target-seeker system for Navy's Eagle air-to-air missile.

• **Goodyear Aircraft Corp.'s** Arizona Division at Litchfield Park will investigate problems involved in the primary extraction of mapping detail from photos made by side-looking radar, under contract awarded by Army Engineer Research and Development Laboratories, Fort Belvoir, Va.

NEW AVIONIC PRODUCTS

• **Resolver standard,** for testing synchros, eliminates need for null detector and a master resolver transmitter and gives direct digital readout which is accurate to within 2 sec. of arc, according to manufacturer. Astrosystems, Inc., 220 East 23rd St., New York 10, N. Y.

• **High-power transistors,** new series of units which can provide 30 watts Class "A," 100 watts Class "B" or 1,000 watts switching, with collector voltages up to 100 volts. Large signal current gain of 70 at 5 amp. can be obtained. New types include 2N173, 174, 277, 278, 441, 442, 443, 1099 and 1100. Bulletin E-397 gives application data. Manufacturer: CBS Electronics, 900 Chelmsford St., Lowell, Mass.



• **Paper tape reader,** the type employed in the Courier delayed repeater satellite, is capable of reading 16 channels of tape but is tightly packaged (14 x 7¼ x 4 in.) and weighs 9 lb. Readers are bidirectional, operate from 28 v.d.c. 150 milliamps source. Manufacturer: Tally Register Corp., 1310 Mercer St., Seattle 9, Wash.

• **Bio-pack,** Model B-30ATP, suitable for acquisition and telemetering of bioelectric signals from the micro to the millivolt range consists of high-gain differential amplifier and FM transmitter operating in the 88 to 108 mc. range. Amplifier has 500 kilohms input impedance, common mode rejection exceeding 50,000:1 and equivalent input noise level of only 4 microvolts peak to peak. Biopack costs $550 and can be obtained on 45 day delivery. Manufacturer: Computer Systems Laboratory, Litton Systems, Inc., 5500 Canoga Ave., Woodland Hills, Calif.

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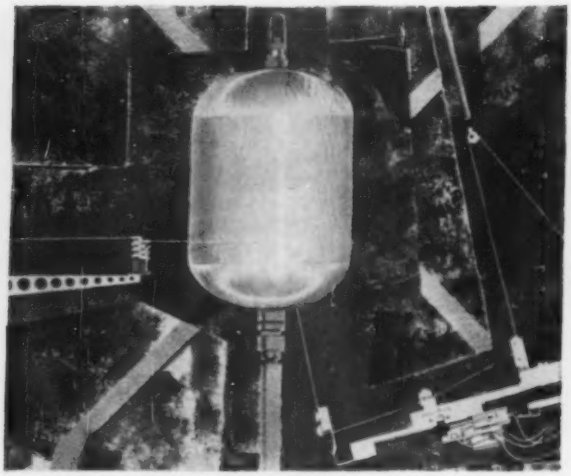
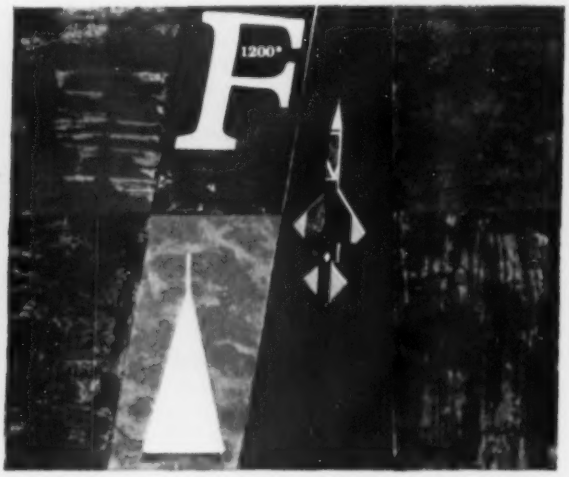
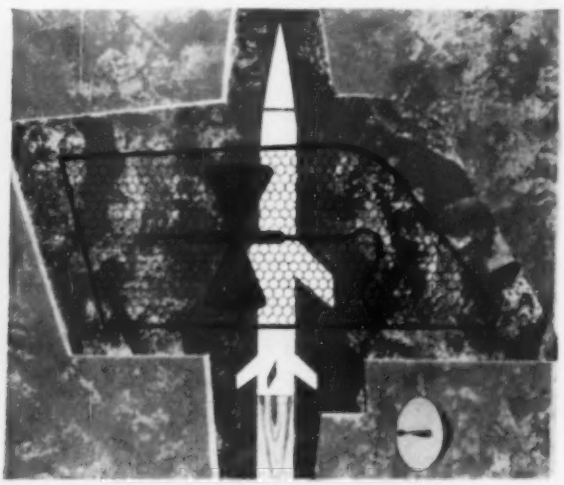


ROCKET MOTOR CASE. Brunswick's exclusive bi-axial Strickland "B" Process of fiber glass filament winding gives S-D ratio to 2,000,000, provides up to 7,500,000 psi modulus. By laying down filaments under tension, SBP excels in making cylindrical shapes, unusual contours, large range of sizes. Pre-stressing gives exactly controlled uniformity.



RADOMES. Brunswick's non-metallic materials boost heat tolerance of radomes and nose cones to 1000-1200°F for limited exposures. SBP filament winding gives highest-ever strength-to-weight ratios with significant weight savings over usual structures. With unmatched electrical uniformity, Brunswick builds to tightest tolerance for dialectric constants and compound configurations.

HONEYCOMB ASSEMBLIES now developed by Brunswick can support two million times their own weight. Brunswick research has created honeycomb assemblies of paper, fiber glass, aluminum and various combinations of these materials. Using the most advanced adhesive systems, these assemblies can be formed in compound curvatures with extremely close tolerances.



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GRUMMAN W2F-1 Hawkeye early warning aircraft serves as a platform for 20-ft.-dia. rotodome which revolves at a 6-rpm. scanning speed. General Electric-designed radar housed in the rotodome provides height-finding and azimuth target information.

W2F Designed for Long-Duration AEW

By Barry Tully

Calverton, N. Y.—Extended endurance, ceiling and improved avionic capabilities mark the Grumman W2F-1 Hawkeye early warning aircraft designed for Navy task force radar protection.

Mission of the twin-turboprop aircraft, which made its first flight on Oct. 21 (AW Oct. 31, p. 27), will be to provide early detection of attacking aircraft and to control intercepts by means of data links between itself and fighter aircraft. To provide complete radar coverage, the carrier-based W2Fs will operate in teams with each aircraft flying a racetrack pattern perhaps 200 mi. from fleet center. Each aircraft will be responsible for detection and intercept control within its defense zone and will relay all information to the task force commander.

To perform this mission, Grumman designed a 50,000-lb. aircraft powered by two Allison T56-A8 turboprop engines rated at 4,050 eshp. each. The aircraft serves as a platform for a circular 20-ft.-dia. rotodome, which revolves in flight at a 6-rpm. scanning speed. The General Electric-designed radar housed within the rotodome provides both height-finding and azimuth target information.

A flight demonstration, flown by project test pilot Tom Attridge, included some 200-kt. passes and a simulated late wave-off with gear and flaps down. The W2F's takeoff, after a relatively short roll, was impressive. One area which may require some attention is a tail bumper on the fuselage which appears to come close to the runway on landing. Approximately 6 hr. of flight have been logged on the W2F.

The aircraft is designed to loiter at maximum endurance airspeeds for long periods. The effective performance of this mission would require on-station times of at least 12 hr., which puts the aircraft's fuel capacity over the 10,000-lb. mark.

The Hawkeye is a pressurized high-altitude aircraft which will perform its mission at an altitude of 25,000 ft. or higher.

In the interests of crew efficiency

W2F Specifications

Wing Span	80 ft. 7 in.
Length	56 ft. 4 in.
Height	16 ft.
Maximum gross weight	49,500 lb.
Engines (2)	Allison T56-A8
Horsepower (each)	4,050 eshp.

SPEARHEAD INTO SPACE Created by Aerolab, the ARGO D-4 four-stage sounding rocket is now being used by NASA for the low-cost acquisition of important data at high altitudes and velocities. A wholly-owned subsidiary of Ryan Aeronautical Company, **Aerolab has developed more space probes and rocket-powered research models, including the Mercury capsule model, which have been fired, than any other firm in the United States.** Aerolab is a science team with quick reaction capabilities—a group of scientists and engineers with special talents for solving advanced problems in astrophysics, aerophysics and geophysics. Thus Aerolab's capabilities are added to Ryan's own in accomplishing breakthroughs in many vital areas of Space technology.

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HAWKEYE is one of the largest aircraft designed for carrier operations. The rotodome must be lowered 2 ft. before the W2F can be taken below deck. The four-fin tail provides directional stability without exceeding 15-ft. hangar deck clearances.

during long flights, the five-man W2F incorporates a high degree of automation both in its flight controls and avionic equipment. The flight controls are full powered with artificial "feel" and the plane will be flown by the autopilot for long periods. Flight instruments are those of any modern all-weather aircraft.

The W2F's avionic system is called the airborne tactical data system. The system is fully automated in the collection, collation, storage and data link relaying of information. Crewmen will monitor the scopes and may interrupt the automatic processes if necessary. Failures in automation can be bypassed by crewmen using alternative modes of operation. Computer system of the W2F was developed by Litton Industries.

The data links from the W2F teams ringing the fleet will supply information of the naval tactical data system on the flagship. This center will process, organize and display target information from all fleet detection systems.

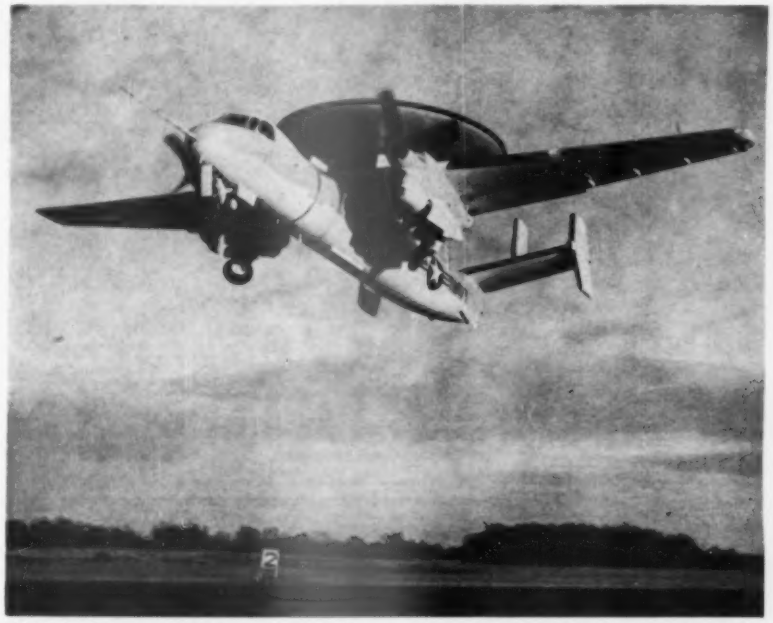
Space limitations of aircraft carrier hangar decks demand that the W2F's rotodome be lowered 2 ft. before the aircraft may be taken below. These same limitations led to the multiple-fin design of the W2F's tail.

The wide split tail of the aircraft has two additional fins extending above the horizontal stabilizer. All four fins have rudder surfaces. Grumman says that this tail design provides directional stability without exceeding 15-ft. hangar deck clearances. The multiple fin design was deemed preferable to the alternative of a single folding fin.

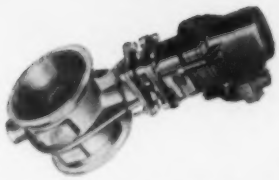
The Allison T56 powerplants of the W2F provide some 8,000 eshp. on take-off. The propellers are by Aeroproducts and are very similar in appearance to those on the Lockheed Electra. Grumman says, however, that the props are modified somewhat to meet the specialized "loiter" requirements. Propellers are full feathering and, unusual on a carrier aircraft, reversible. Reverse pitch, though not in the original specifications, was in the prop design and was retained to enhance the aircraft's landing performance at land bases.

The 80-ft. wing span of the W2F places it among the largest aircraft designed to operate from aircraft carriers. Its 49,500-lb. weight, however, is considerably less than the Douglas A3D and even less than the North American AJ so that it should create no new handling problems. The aircraft, like the Grumman A2F, is designed for nose gear catapult launches (AW Jan. 11, p. 115), permitting automatic engagement of the catapult shuttle.

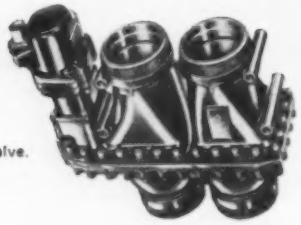
The W2F is unquestionably a considerable improvement over the Grumman WF-2 early warning aircraft now operating in the fleet. The WF-2 (AW Jan. 11, 1960, p. 85), which stemmed from the low-altitude S2F design, lacks the speed, endurance and altitude capabilities of the turboprop aircraft. Even more important, ATDS developed by Litton Industries is expected to be vastly superior to the avionic system of the smaller aircraft. The WF-2 Tracer, which replaced the Douglas AD-5W, will bridge the gap until the Hawkeye joins the fleet.



MAIN landing gear swivels up into nacelles of Allison T56-A8 turboprop engines rated at 4,050 eshp. each. Aircraft is designed for nose gear catapult launches.

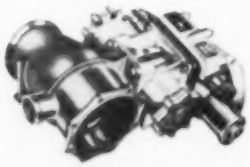


High pressure, high temperature butterfly valve.



Hot gas control valve.

Ice pre-sensing and control devices.



High temperature pressure regulator.

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by R. B. WORL
Sales Manager
Precision Products Division

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MAXIMUM running time of English Electric's Mach 4 test tunnel is 41 sec. at Mach 3.4.

Two Tunnels Augment English Electric's R&D

London—Mach 4 tunnel at English Electric Aviation's Warton flight development field shows basically the same design philosophy as that adopted by Lockheed and Convair.

The tunnel has a four-foot-square working section and is supplied from a 600 psi. reservoir.

A Mach 6 missile tunnel with a working section of 18 in. sq. has been erected alongside the larger tunnel in order to use the same air supply. Together, the tunnels have cost $2 million and have taken nearly five years to design and build.

Since the Mach 4 tunnel came into operation earlier this year it has been used on investigations on the TSR.2 and supersonic delta airliner configurations. The smaller tunnel is still undergoing commissioning trials.

With these two tunnels English Electric claims to have the most extensively equipped, privately-owned research, development and flight test establishment in Europe. The company has spent $11 million on facilities at the test field since 1950.

The Mach 4 tunnel has supersonic and transonic sections in tandem, and is designed to cover the speed range Mach 0.4 to 4.0. Minimum Reynolds number of five million for a typical eight-inch model chord can be maintained throughout the speed range. Maximum running time is 41 sec. at Mach 3.4.

The weapons tunnel covers the speed range Mach 1.5 to 6, corresponding to full-scale flight at heights around 80,000 ft. and above. Running time envelope extends from 30 to 500 sec.

Total power supply is only 1,640 hp., provided by two electric motors driving a pair of three-stage piston compressors which can totally recharge the air reservoirs in one hour.

The air is stored in four cylindrical vessels, six feet in diameter, 90.5 ft. long, which contain fully charged 34,000 lb. of air at 600 psi.

Features of the flexible nozzle adjustment system in the Mach 6 tunnel are claimed to enable a fine setting of the nozzle plates to within 0.001 in. in 10 in. of the nozzle contour required. Fourteen jacks react the flexing plates against a large number of thrust blocks

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along the profile. Tunnel profile can still be changed in less than one-half hour. Both tunnels have diffusers which can be adjusted during a run.

Instrumentation of the Mach 6 tunnel is based on an advanced high speed data extraction system. Test instruments and transducers are d.c. excited and their millivolt outputs, which are a direct analog of the quantity being measured, are fed directly to the data handling installation, converted to digital form and stored. The analog system which runs in parallel with the digital system is a 12-channel galvanometer recorder which provides a "quick look" facility as the test proceeds.

The digital data system can handle eight separate channels and can cope with 80 data points per second. Model pressure surveys are carried out with a General Design Corp. scanivalve capable of scanning 48 points per second.

Schlieren presentation is also duplicated by use of twin light sources to give visual and flash photographic access.

Control valve in the Mach 4 tunnel was supplied by Johannes Erhard H. Waldenmaier of Heidenheim, West Germany. No British company would guarantee response characteristics of such a valve. The valve has been the major cause of delay in opening the tunnel.

Wheeled model cart of the Mach 4 tunnel carries the complete model support and incidence changing mechanism together with the associated electrical and hydraulic equipment. A complete automatic incidence program can be preset to operate during a tunnel run. The sting joints have been made interchangeable with other British supersonic tunnels. A cranked sting has also been designed which can be rotated at both ends of the crank to set up yaw angles of up to five degrees.

Model cart on the smaller tunnel provides facilities for continuously pitching, continuously rolling or combinations of both movements of the model. One of the major differences between the maneuvering facilities of the two tunnels is the much higher degree of roll possible in the missile tunnel, which can roll the model at up to two revolutions per second.

The quadrant may be used for force and moment or pressure measurements on a model. The changeover from force and moment to pressure measurements is achieved simply by unplugging from the rear end of the quadrant boss, the unit containing the slip ring, roll transducer, etc., and replacing it with one containing the scanivalve, roll transducer, etc.

The test department has also developed a six-degree of freedom flutter simulator.

The first warning alerted posts all over the United States and Canada. Unidentified airborne objects seemed to be approaching at supersonic speeds from many directions. ¶ Simultaneously in control centers throughout North America men and machines dealt with torrents of data. Watching blips on radar scopes, crews made decisions which ordered weapons to destroy the attackers. Interceptor pilots reported over loudspeakers. As the enemy reacted and shifted, fresh instructions crackled through command phones. ¶ But no rockets were fired. No bombs fell. The blips came from magnetic tapes made by a single high-speed computer. Called Operation Desk Top, this was a simulated raid—the most gigantic ever arranged—to exercise the North American Air Defense System. In planning it, SDC made four billion calculations and six and one-third miles of magnetic tape. ¶ To train managers in decision-making, to exercise decision-makers under realistic stress, to avoid costly errors in actual operations—these are some of the purposes of SDC's pioneering work in systems research and development. ¶ **SYSTEM DEVELOPMENT CORPORATION.**

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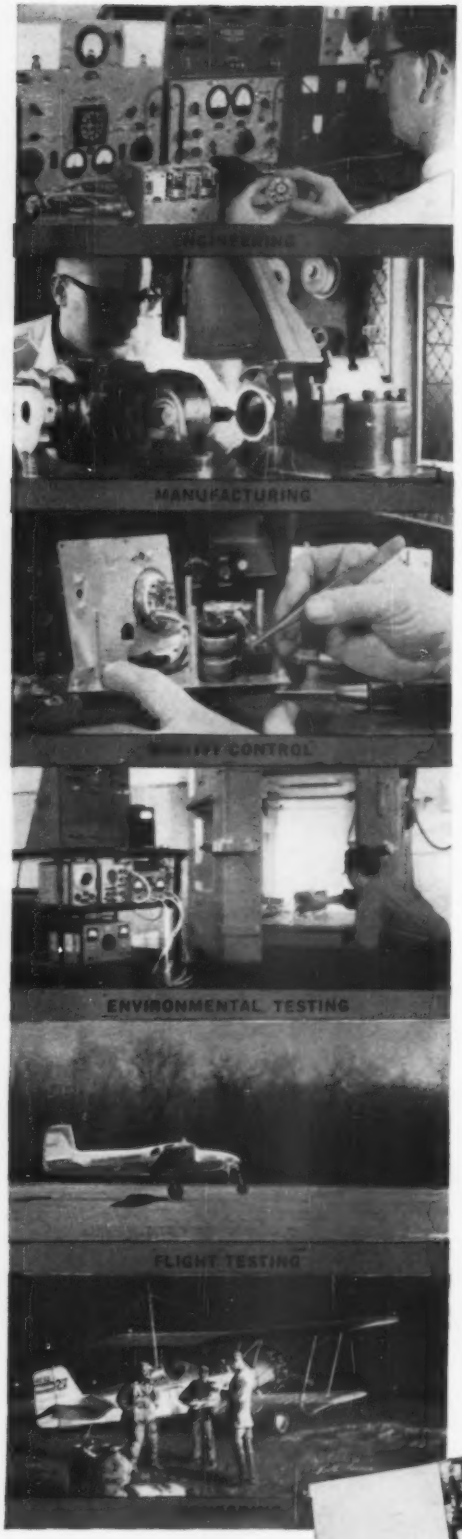

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British League Proposes Aviation Bureau

By John Tunstall

London—Initial effort of the British Executive and General Aviation group (Beagle) may consist of "substantial redevelopment of the high wing Auster family of aircraft," according to Peter Masefield, managing director of Beagle. He indicated that all new aircraft would be low winged tricycle gear monoplanes, but declined to discuss design details of any specific project.

In outlining Beagle plans to AVIATION WEEK, Masefield emphasized the group's intention to cover all categories in the general aviation field. Masefield would not indicate whether there would be any entirely new high wing airplanes from Auster, but said it was intended to make Auster the high wing specialists in the group.

Creation of a General Aviation Department of the Ministry of Aviation to revitalize British club flying was urged in a recent report issued by the influential Air League.

The report calls for a government-maintained network of airport facilities based on freer use of Royal Air Force and abandoned airfields, allocation of three to four radio frequencies, direct financial assistance for sporting clubs and flying organizations, and abolition of the fuel tax. The Air League also urges reduction of the import duty on foreign business and personal aircraft.

Growth in popularity of general aviation during the past year has surprised both the industry and foreign aircraft distributors. Sales this year of imported aircraft already have exceeded $3 million and 60 new buyers of general aircraft have raised the total of company-owner machines to 90.

British manufacture of club and executive aircraft is likely to rest solely on the Beagle group (AW Oct. 17, p. 27), with the possible exception of Short Bros. Light Aircraft Division.

Plane Design

No major divergencies in concept, construction or performance are likely to show in new Beagle aircraft, Masefield told AVIATION WEEK. Masefield currently is heading a crusade in England to get the country into the general aviation business.

Competing with the Beagle organization will be the distributors of all the major U. S. general aviation companies. Beachcraft distributor in Britain is the recently formed Light Aircraft Division of Short Bros. & Harland. British United Airways is handling Cessna aircraft and Vigons Aviation, Ltd., of Kidlington, Oxford, is the sole British agent for Piper. Piaggio's agent is Air Enterprise, Ltd., of Boreham Wood.

General Aviation

The British Aircraft Corp. is definitely not interested in general aviation and a spokesman of the de Havilland company told AVIATION WEEK that there were no known plans to extend the company's range downward from the DH Dove and the Heron.

Negotiations between British engine companies for the manufacture of Continental and Lycoming engines which are likely to power all British general aviation aircraft are reported to be proceeding satisfactorily. Unofficial reports suggest that the negotiations between Rolls-Royce and Continental are virtually completed.

F. G. Miles, Ltd., would concen-

U. S. Exports of Aircraft, Parts

Item	July 1960		Cumulative Totals January-July 1960	
	Number	Value ($1,000)	Number	Value ($1,000)
Aircraft, parts, and accessories, total	...	135,308	...	838,540
Commercial and civilian aircraft, total	242	72,586	1,416	326,739
Aircraft 3,000 lb. and over empty airframe weight:				
Cargo transports, commercial, new	...	...	...	...
Passenger transports, commercial, new:				
3,000-14,999 lb. empty airframe weight	4	522	34	3,915
15,000-29,000 lb. empty airframe weight	1	1,050	4	3,744
30,000 lb. and over empty airframe weight	12	66,830	58	287,991
Rotary wing aircraft, commercial, new	...	...	3	988
Commercial and civilian aircraft, used and rebuilt, including converted	9	1,085	75	11,713
Aircraft under 3,000 lb. empty airframe weight:				
Utility, commercial and civilian, new:				
3 places and under	40	334	223	1,765
4 places and over	122	2,196	702	12,063
Rotary wing, commercial, new	5	213	50	2,634
Commercial and civilian aircraft, used and rebuilt, including converted	47	342	264	1,904
Commercial and civilian aircraft, new, n.e.c. (all empty airframe weights)	2	14	3	22
Aircraft engines, reciprocating, new air-cooled under 400 hp[1]	160	373	939	2,298
Aircraft engines, reciprocating, used and rebuilt	154	868	875	5,959
Aircraft components, parts, and accessories, n.e.c.[2]	...	61,481	...	503,544

Source: Bureau of the Census.

*Revised.

[1]Air-cooled reciprocating engines, new, 400 hp. and over are included in "Aircraft components, parts, and accessories n.e.c."

[2]Includes military aircraft.

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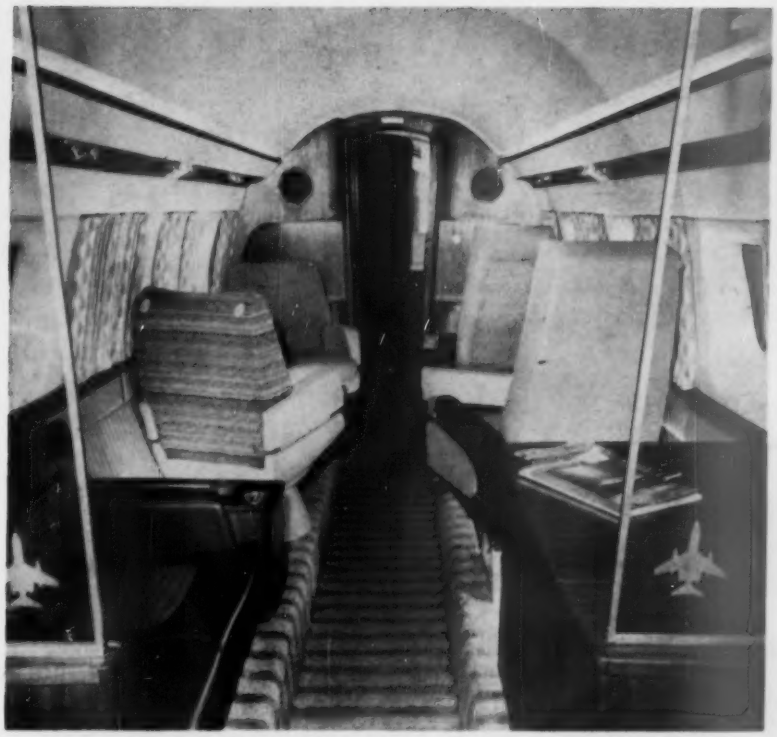

AiResearch Builds JetStar Executive Mockup

Mockup of an executive interior for the Lockheed JetStar transport was designed and built by Garrett Corp.'s AiResearch Aviation Service Division. Center aisle is at lower level than the furniture deck, to give more headroom. Aisle leads to galley and lavatory.

trate on the small low wing type of private aircraft, a field in which Miles Aircraft was famous before World War II.

In the present set-up, Masefield said, Miles has only the status of an associated company, but it was hoped they would get closer "as time goes by."

Entirely new aircraft in the executive category will be the responsibility of Beagle Holding Co. itself, and will clearly reflect Masefield's own thinking. A separate production facility might well be laid down for this category. Aircraft will range from four to 12-seat models. In the main, executive airplanes in Britain would be flown by professional pilots, but the company might produce a "more forgiving" type of aircraft with lower performance which could be flown by amateurs.

Flying Cost

Masefield has given himself about 10 years in which to get Beagle aircraft established in all categories. Flying for fun may then cost no more than the first cost and upkeep of a small sports-car, and business flying no more than the maintenance of a large car.

In Masefield's view, a range of aircraft superior to U. S. aircraft was not an absolute necessity for Britain to succeed in the general aviation world. "A British airplane does not have to be any more radically different from an American airplane than does a British Ford automobile from its American counterpart." He said it was a giant multi-million dollar market which would exhibit the same expansion characteristics as did the world's automobile industry.

Masefield's thinking is uninhibited by the nastiness—even to professional pilots—of British weather. Neither is he concerned with the small dimensions of British fields, the menacing presence of the world's most extensive electric grid system, and a concentration of vast, built-up areas linked by a complex of rail, road and rivers which make the task of map reading at low level formidable even to experienced pilots.

"The winter weather on the east coast of the U. S. is every bit as bad as Britain's," he said, adding that flying seemed to have prospered there.

The problem of air traffic control, which a growth in general aviation would introduce, is also regarded by Masefield as having been greatly exaggerated, at least in the case of executive aircraft. He admitted that necessary radio and navigational aids for all-weather flying would cost an additional $20,000 but this he reckoned was

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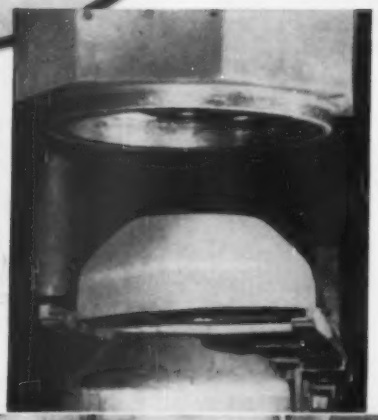

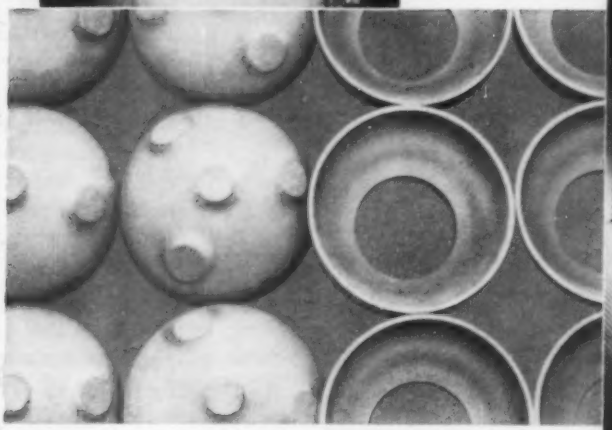

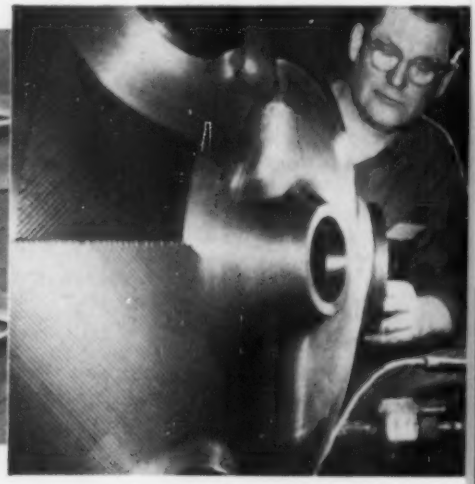

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GRAFTON MASSACHUSETTS LOS ANGELES CALIFORNIA PALO ALTO CALIFORNIA FORT WORTH TEXAS

GAT Transponder

General aviation transponder (radar), called GAT for short, weighs only 12 lb.; measures only 13 x 8 x 4 in., and consumes only 2 amp. at 28 vdc. Transponder, developed by Hazeltine Corp., under Federal Aviation Agency sponsorship, has 150 mi. range and provides 64 traffic control codes plus emergency code. Hazeltine and National Aeronautical Corp. (Narco) are discussing possible arrangement whereby Narco would sell and service the unit, when it becomes available next year.

an acceptable expenditure for a company-owned aircraft.

The Collins range of radio equipment was already scheduled for manufacture in Britain he said. There was also the possibility that the Lear single axis autopilot would also soon be made under license.

Short Bros. Plans

In an explanation of Short's general aviation policy, Frank Robertson, chief engineer of the Light Aircraft Division, went further than Masefield in his admiration of U. S. designs. The company took up the Beechcraft agency because of its intention of being immediately effective in securing a share of the rapidly growing company-owned aircraft market. "In our opinion," said Robertson, "the Beechcraft Queen Air is the optimum business aircraft currently available and has a good decade of development ahead of it." He said it would take any British manufacturer at least three years to produce an airplane at all competitive.

The company is developing the Skyvan because the worldwide requirement for a small general purpose light aircraft is not adequately met by any existing product. The company is planning an initial batch of 25 Skyvans, and if the demand for any particular Beechcraft model justifies, Short will consider assembly at Belfast, Ireland.

Airwork Services—the British United Airways subsidiary handling the Cessna range—is so impressed with sales this year that the company intends to stock a full range of aircraft. Sales this year have reached a total of 32 aircraft. Breakdown shows that one-third went to companies, another third equally to farmers and flying clubs and the remainder to private buyers.

World Wide-Van Nuys Opens Aircraft Facility

World Wide-Van Nuys, a branch of World Wide Helicopters, has opened its new $150,000 airport facility on 13½ acres of land at the northwest end of the Van Nuys airport. Facility includes 30 tie-down spaces and a 12,000-sq. ft. hangar which houses aircraft, maintenance and general offices. Firm offers such services as refueling, direct weather teletype, snack bar, lounge, reservations service, car rental, showers and dressing rooms and general maintenance of aircraft including engine and airframe overhaul for airplanes and helicopters.

PROBLEMATICAL RECREATIONS 39

All other things being equal, which will cause the greater racket, two arguing E.E.s at a distance of four feet from you, or three arguing M.E.s at a distance of six feet? —*The California Engineer*

Engineering design kits containing standardized electronic hardware for prototype buildup are offered by our U.S. Engineering Co., Division. USECO distributors have full information.

ANSWER TO LAST WEEK'S PROBLEM: The first singular scientist removes 1/7 of the grindstone by taking off $(\sqrt{7} - \sqrt{6}) / \sqrt{7}$ of the diameter. The next removes $(\sqrt{6} - \sqrt{5}) / \sqrt{7}$ of the diameter, the third removes $(\sqrt{5} - \sqrt{4}) / (\sqrt{7}$ and so on until the last one receives as his share a small grindstone whose diameter is $\frac{1}{\sqrt{7}}$ of the original diameter.

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Beverly Hills, California

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FOUR to five-seat L200 Morava, used for touring or medical evacuation, is built by National Aircraft Works, Kunovice, Czechoslovakia.

Czechs Gain Light Plane Market in West

WITH auxiliary fuel tanks installed, L200 Morava A can fly the shorter international routes (AW Oct. 17, p. 47). Below, interior of the Aero 145 four-seater is examined by onlookers.

By Edith Walford

Prague—Omnipol Foreign Trade Corp.'s recent drive to extend its markets to the Western Hemisphere is meeting with some success. Although exact figures are not available, Omnipol says that exports of aircraft, including spare parts and accessories, were up 42% in 1958 compared with 1956, and that last year's results boosted this figure to 151% over 1956 exports.

Best seller among the Czech small aircraft is the L40 Meta-Sokol all-metal, low-wing, four-seat monoplane for sports flying and touring. So far, 15 of these have been supplied to West Germany, 11 to Australia, England, Norway, Finland, Sweden, Denmark, Austria, Poland, Hungary, Persia, Brazil, Argentina, Chile and most recently Spain are among the countries where this type is becoming very popular, particularly for pilot training and blind flying purposes.

Czechoslovakian light aircraft industry this fall showed a complete range of its aircraft at the second Brno International Trade Fair under the auspices of government-controlled Omnipol.

Included in the display were models of the Z326 A Trener Master, L200 Morava A, Aero 145, L40 Meta-Sokol and the L-13 Blanik sailplane.

According to the Czech Ministry of Precision Mechanics, which also governs the Czech aircraft industry, Czechoslovakia is the world's second largest producer and exporter of small transport and sport aircraft within the 2,000 kg. (4,409 lb.) flight weight and up to five-seat capacity range.

Target of the Czech aircraft industry's third five-year production pro-

INCLUDED in display at Brno were, from left, Z326 A Trener Master, L200 Morava A, Aero 145, L40 Meta-Sokol, L-13 Blanik sailplane.

gram recently announced by the same ministry to begin in 1961 is: continued production of the Trener Master and Morava series for air taxi services; continued production of the L-13 Blanik all-metal, two-seat tandem sailplane and work on the development of a standard type glider; accelerated development of STOL and VTOL aircraft specifically aimed at increasing air taxi services for the transport of passengers and/or cargo.

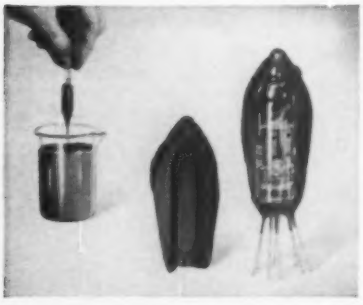
Airport lighting equipment and aircraft accessories occupied a large section of the Brno indoor display. Since Omnipol first introduced Czech airport lighting equipment at last year's Brno Trade Fair, complete installations have been supplied to Bulgaria's Sofia, Hungary's Budapest and East Germany's Leipzig airports in addition to six major airfields in Russia. By the end of this year, three more airports in Russia will have been added to the list.

LATEST in Z226 Trener Master series is this single-seat Z326 A. Designed for acrobatics, Z326 is equipped with retractable gear.

General Electric Silicone Rubber finds dozens of uses in missile systems. How many more will prove vital?

General Electric silicone rubber has the "thermal toughness" to stand up under the searing heat of rocket blast-off or possible atomic attack. Add very good electrical properties and excellent resistance to aging, weathering, moisture, flame, ozone and corona and you can easily see why silicone rubber is now being used in virtually every U.S. missile and space vehicle.

Since both space technology and silicone rubber are relatively new, General Electric believes there are many more areas not yet explored where silicone rubbers can help keep a missile functionally reliable and combat-ready. To help designers in their evaluation work, we list here the principal properties and applications of G-E silicone rubber.



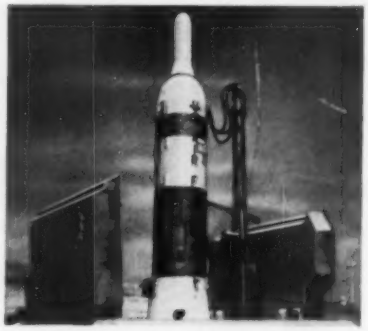
RTV LIQUID SILICONE RUBBER — One of the most versatile materials developed in recent years, RTV is a liquid rubber that cures at room temperatures. Like all silicone rubber, it remains flexible over a wide temperature range and is virtually ageless. Since it comes in a wide range of viscosities, it can be poured, sprayed, dipped, painted or applied with a pressure gun or spatula. It bonds tightly to metal when a primer is used. When not primed, you can readily remove RTV and then reapply more. You can impregnate tightly wound coils with RTV or form sections several inches thick.

You can control cure time from two minutes to 24 hours. These are RTV's typical properties:

Viscosity	from 120 poises (very pourable) to 12,000 poises (paste)
Specific Gravity	1.2 to 1.5
Solids Content	100%
Shrinkage	0.2%
Heat Resistance	from —90°F to 600°F, and as thermal insulation, in 5500°F flame for minutes
Ozone Resistance	Comparable to Mica
Electrical Properties	See last table

Applications—RTV is used as a high temperature structural sealant in missiles, satellites and space vehicles. It is used to pot and encapsulate electronic components and assemblies for electrical and heat insulation and for protecting delicate components from physical damage. It is commonly used as an impregnating insulation in transformer coils, to pot and hold cable in raceways and to pot cable breakouts. You can make flexible molds with RTV and hence make accurate, duplicate castings from originals.

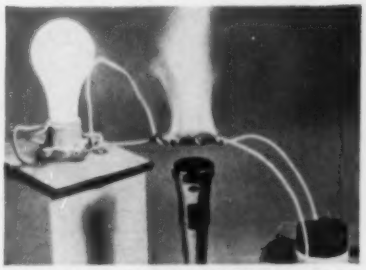
RTV is an excellent thermal barrier and as such is applied on and around missile nozzles. Tests show RTV's resistance to flame temperatures as high as 5500°F for several minutes. RTV also functions as a flexible ablative material and is used around probe holes, along raceways, and between stages and structural joints on the missile skin.



HEAT CURED SILICONE RUBBER PARTS —Silicone rubber gaskets, port seals, O-rings, shock mounts and other mechanical parts are not only used on missiles but have wide application in ground support equipment. For instance, missile silo doors use silicone rubber seals that will stand up to outside weathering, ozone and abuse for years and which will also resist the heat of missile launching and nuclear attack. Silicone rubber also resists brief exposure to cryogenic materials.

Silicone rubber has long-lasting temperature resistance from —150°F to 600°F, with excellent electrical, weathering, ozone, corona, radiation and non-aging properties at these temperatures. High tensile strength and low compression set are also within its range of desirable properties:

Tensile Strength, psi	800—1500
Elongation, %	100—600
Hardness Durometer (Shore A)	25—80
Compression Set, %	10—80
Tear Resistance lb/in	40—200
Radiation Resistance	1×10^8 roentgens
Electrical Properties	See table below



WIRE AND CABLE INSULATION — The long term reliability of silicone rubber when operating in high ambient temperatures and when current over-loads cause the conductor to approach 500°F is an important feature of silicone insulation. In an 1800°F flame, specially constructed silicone rubber insulated cables will continue to insulate for hours, forming a non-conductive ash that gives off no toxic fumes. And short term reliability is obtained even when silicone rubber is exposed momentarily to a direct flame of 5500°F.

Because of this excellent heat resistance, more current can be carried than in conventional cable (or smaller cable can be used). Other features: best compression set of all elastomers at temperature extremes, so that silicone rubber wire and cable does not deform under clamps; high ozone, corona, radiation and weather resistance, low moisture absorption, flexibility down to —100°C. These are the typical properties:

Volume Resistivity	10^{15}—10^{16}
Dielectric Strength, volts/mil	600—650
Dielectric Constant, 60 cps	3.0
Power Factor	.0010—.0050
Radiation Resistance	1×10^8 roentgens
Physical properties	Similar to table above.

Applications—Wiring harness made of silicone rubber insulation is often found throughout missiles. Cable offers added reliability for use in various places throughout the launch complex below ground from power plant to silos. All combat vessels built for the U.S. Navy during the last ten years, including fleet ballistic missile submarines and the new nuclear-powered cruiser and aircraft carrier, have silicone rubber insulated cable installations in all fixed wireways. In every case, silicone rubber is chosen because it is virtually non-aging, stands up to intense heat better than any other flexible insulating material, and continues to operate even when subjected to fire.

●

There are many more places where G-E silicone rubbers' inherent properties can be vital in missiles, satellites and space vehicles. For further data, call your nearest G-E sales office or write Section J1133, **Silicone Products Department, General Electric Company, Waterford, New York.**

Progress Is Our Most Important Product

GENERAL ELECTRIC

Cessna Model 310F for 1961 (AW Oct. 24, p. 31) has sharper nose lines, tip tanks and addition of a third window at rear of cabin. Aircraft is powered by 260 hp. Continental IO-470-D engines and will sell for $62,500 in the standard version at the factory. Aircraft is one of six new models unveiled by Cessna for its 1961 line.

Cessna Unveils New Model 310F Twin, Skywagon

Utility aircraft, the Skywagon, is designated Model 185, was designed in response to what Cessna said was a demand for expanded mission and performance requirements, particularly for heavier payloads than those carried by the Cessna 180. Plane can carry six adults plus 270 lb. of baggage; price is $18,950 for the standard aircraft at the factory. It cruises up to 172 mph.

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attuned to new applications

This Litton continuous wave magnetron is one of a family of ten that gives coverage from P to X bands at minimum power outputs from 250-500 watts.

The dependability and versatility of Litton CW magnetrons has been time-proved by the many thousands in field service. There are undoubtedly long years of operation ahead in new military and commercial applications.

These Litton CW magnetrons are mechanically-tuned and liquid-cooled. We also manufacture CW magnetrons with versatile hydraulic tuning and, at lower powers, can supply them with forced air cooling.

Litton CW magnetrons are being applied in a pulse width modulated navigation system. Pulse rate, amplitude and frequency modulation techniques make possible other communication applications. This family also offers many advantages in such CW applications as RF drivers, industrial processing and component testing. They can be pulsed to approximately 2 KW peak power at a .25 duty cycle, a desirable attribute in component testing.

Investigation of these magnetrons and Litton pulse magnetrons, the international standards of excellence, may lead you to new applications. If we have stimulated your thinking a little, we *would* like to hear from you. Write to: 960 Industrial Road, San Carlos, California.

CW MAGNETRONS

Type Number	Frequency Range Megacycles	Minimum Power Watts
L-3456	350-590	500
L-3459	590-975	500
L-3465	975-1500	400
L-3464	1500-2350	400
L-3460	2350-3575	500
L-3461	3575-4975	400
L-3467	4975-6175	400
L-3468	6175-7275	300
L-3462	7275-8775	300
L-3463	8775-10,475	250

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Civil Aircraft, Engines Shipments

Item		1960 August	Cumulative totals Jan.-Aug. 1960
Complete aircraft, total airframe weight	1,000 lb	2,031.7	19,876.4
By weight of plane:			
Under 3,000 lb. airframe weight	do	395.9	5,643.2
3,000 lb. airframe weight and over	do	1,635.8	14,233.2
By number of places:			
1- and 2- place	do	362.5	5,215.4
3- and 5- place	do		
Over 5-place	do	1,669.2	14,661.0
By total rated horsepower, all engines:			
Under 100 hp	do	303.5	4,425.6
100-399 hp	do		
400 hp. and over	do	1,728.2	15,450.8
Aircraft engines:			
Reciprocating	Number	873	7,387
Gas turbine	do	(D)	(D)
Aircraft engines, total horsepower:			
Reciprocating	1,000 hp	178.3	1,560.5
Gas turbine	do	(D)	(D)
Complete aircraft	Number	420	5,692
By weight of plane:			
Under 3,000 lb. airframe weight	do	379	5,367
3,000 lb. airframe weight and over	do	41	325
By number of places:			
1- and 2- place	do	367	5,214
3- and 5- place	do		
Over 5-place	do	53	478
By total rated horsepower, all engines:			
Under 100 hp	do	331	4,750
100-399 hp	do		
400 hp. and over	do	89	942
Value of shipments of complete aircraft and parts, total	$1,000	106,690	956,970
Aircraft, total	do	97,534	882,078
Under 3,000 lb. airframe weight	do	7,099	98,790
3,000 lb. airframe weight and over	do	90,435	783,288
Aircraft parts	do	9,156	74,892
Value of shipments of aircraft engines and parts, total	do	9,651	110,716
Aircraft engines:			
Reciprocating	do	2,269	18,781
Gas turbine	do	(D)	(D)
Engine parts	do	7,382	91,935
Unfilled orders (planes 3,000 lb. airframe weight and over)	Number	591	...

* Revised.
D—Withheld to avoid disclosing figures for individual companies.
Source: Bureau of the Census.

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Bendix Systems Division, prime contractor for major satellite communications programs including ADVENT for the Signal Corps and STEER for the Air Force, and major missile weapons systems such as the Navy's EAGLE, offers career opportunities in:

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theoretical analysis
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microwave circuit design
mechanical design
satellite packaging
propagation

Also, Project Engineers, 3-10 years' communication experience, for satellite, ground, anti-jam, and antenna subsystems.

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carrier a/c installation
guidance systems analysis
airborne intercept radar
solid rocket propulsion
airframe design
warheads
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guidance equipment
cockpit displays
operational analysis
flight test

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PUBLISHING DATE: Mid-December

CLOSING DATE: November 15, 1960

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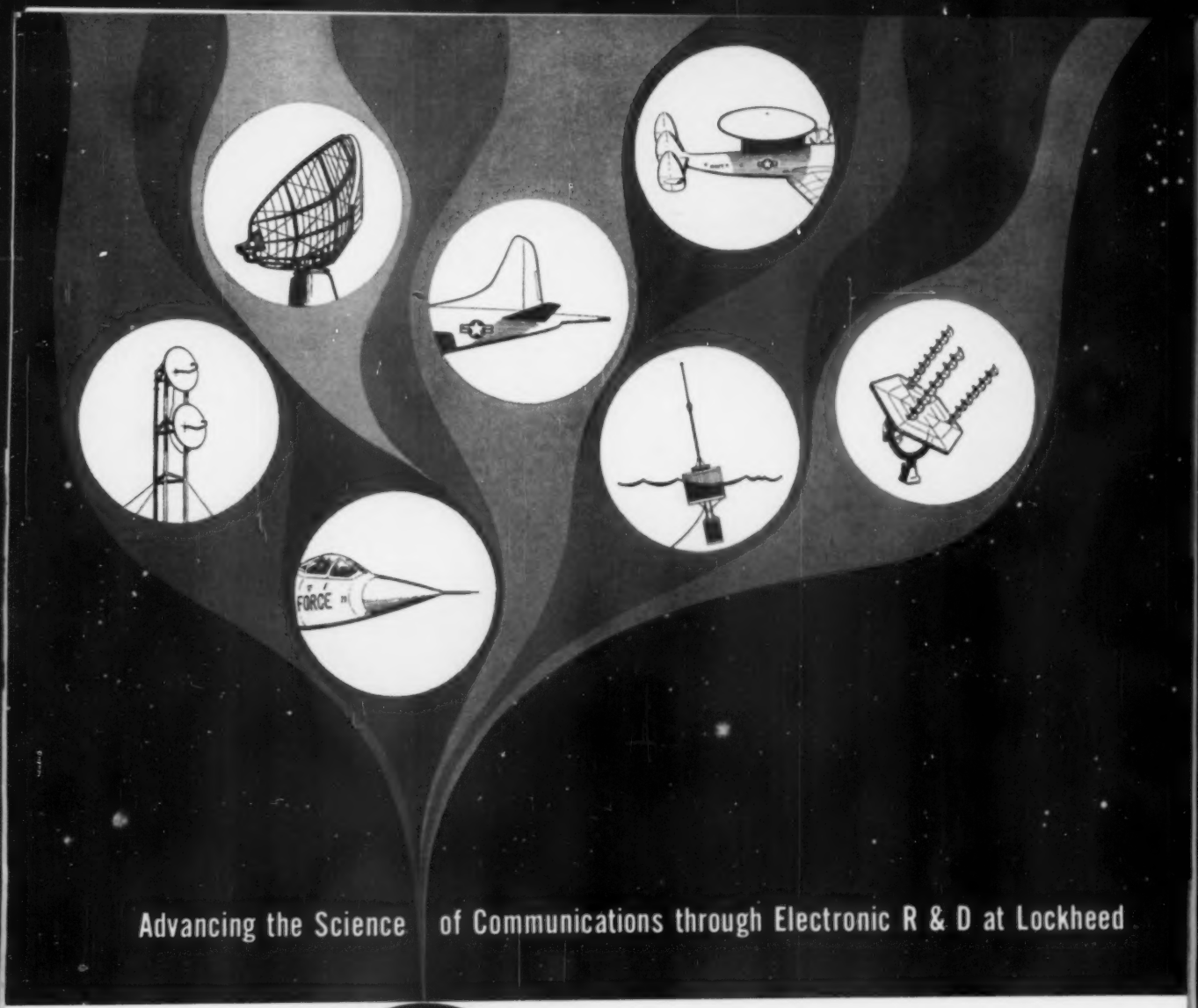

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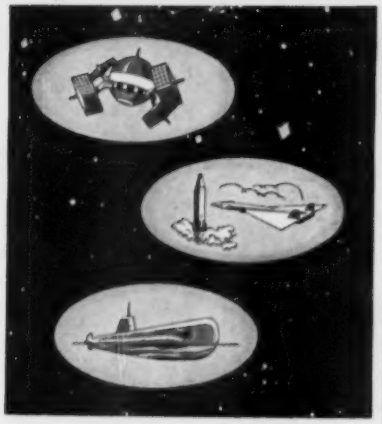

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Soviets Study Helicopter As Ore-Hauling Vehicle

Moscow—Soviet Union is studying the possibility of using helicopters to haul ore from deep open-pit mines to the concentrating plants where the ore is processed.

One Soviet survey indicates that a helicopter capable of carrying a minimum load of 5-7 metric tons may be more economical for the hauling job than conveyers, trains or trucks when used in an open pit at least 650 ft. deep. Russians say some ore pits are slated to reach depths of 1,300-2,000 ft. "in the near future."

Helicopters would hook onto dump-bottom buckets in the mine pits, and the buckets would be emptied directly into hoppers at the concentrating plants on the surface. Development of turbine-powered helicopters capable of carrying 15-20 metric tons would provide further savings, according to the Soviet study.

PRIVATE LINES

Aero Design & Engineering Co. has changed its corporate name to Aero Commander, Inc. Tom Harris, vice president and general manager, said the change will more closely associate the company with its executive transport line. Company is a wholly-owned subsidiary of Rockwell-Standard Corp., Coraopolis, Pa.

Skycraft Design, Inc., West Trenton, N. J., recently made its 1,000th metal conversion when the Westchester Aeronautical Corp. of White Plains, N. Y., accepted delivery of its metallized 1957 Piper Tri-Pacer at the Mercer County Airport, N. J.

Dornier-Werke GmbH. of Munich has begun deliveries of its six-seat, twin-engine Do-28 STOL aircraft first introduced at this year's Hanover air show. First two models off the production line have been delivered to Deutsche Taxiflug GmbH., Mannheim, one of a steadily increasing number of companies in Germany running charter, tie-in or aero-taxi services (AW May 23, p. 102). Deutsche Taxiflug has ordered a total of four Do-28s.

Canadian National Aviation Museum opened Oct. 25 at Ottawa International Air Terminal. Displays cover 13,000 sq. ft. of floor space.

Burke Lakefront Airport has opened its new terminal building at the downtown Cleveland, Ohio, location. Five-story air traffic control tower is under construction.

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For more information please write to: Mr. A. L. Bowman, Engineering Personnel, North American Aviation, Inc., International Airport, Los Angeles 45, California.

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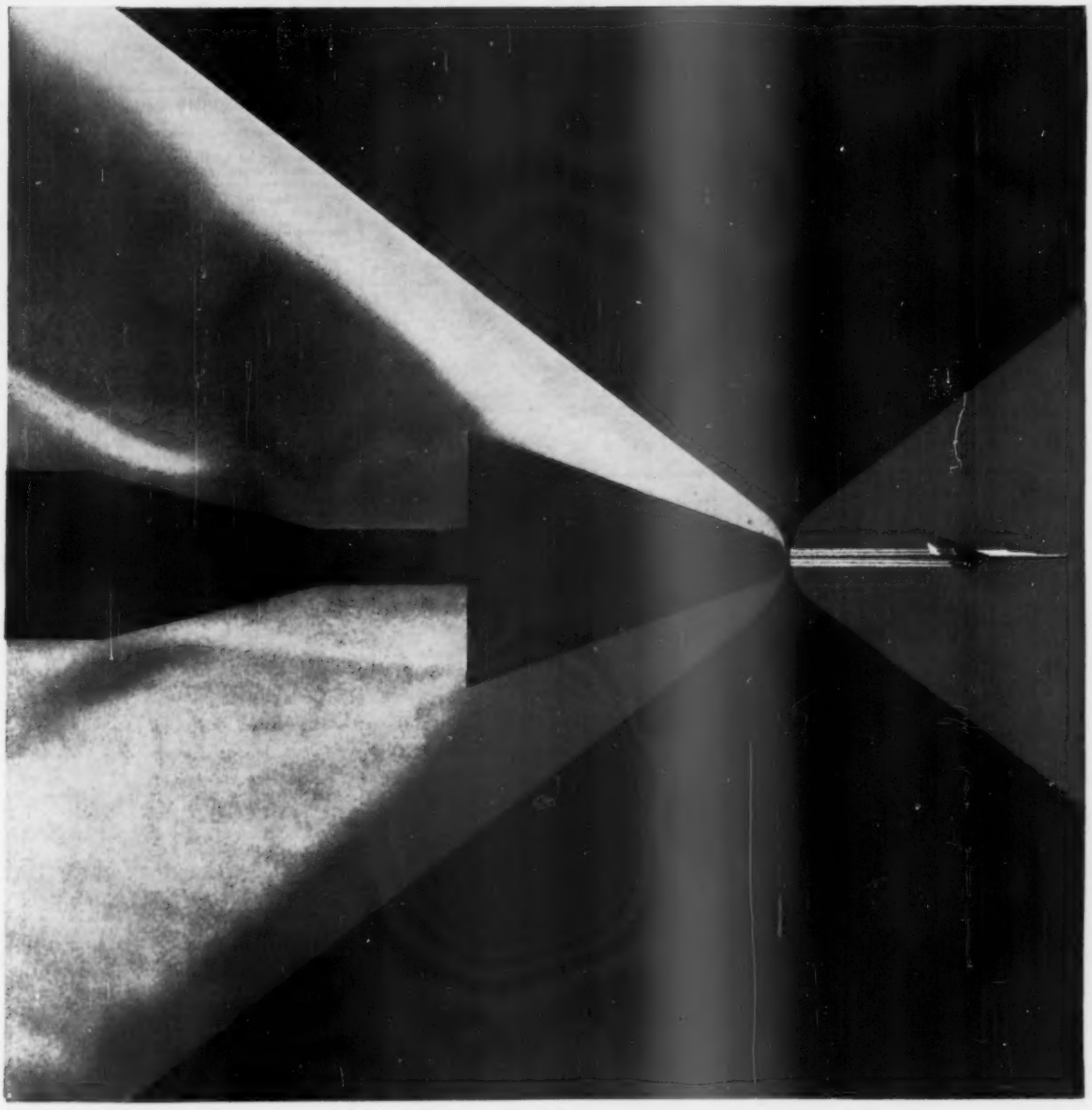

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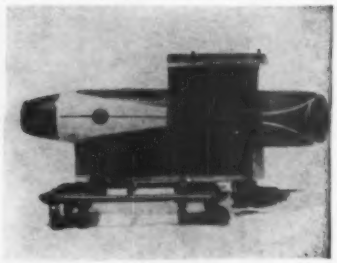

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LETTERS

End in View

Purely as a matter of convenience to normal readers, and as a great help to those of us who diligently clip AVIATION WEEK articles, would it be possible for you people to incorporate a large black dot or rectangle to signal the end of an article that proceeds for several pages? Due to the technical nature of the writers, they often simply run out of words and stop, with no indication in the context that they are coming to the end. Most distressing.

Thank you.

FREDERICK A. RAITCH
Aero Engineer
Wright Field
Dayton, Ohio

(Good idea. We will.—Ed.)

Airline Odyssey

Idlewild is gorgeous! Wonderful buildings! Beautiful fountains! Large parking areas! Unfortunately, it is not a good airport. Somewhere in the plan the traveler, particularly the foreign arrival, has been overlooked. Customs is fine and operates efficiently.

But what follows customs?

For one thing, baggage cannot be checked through New York so the arrivee has his bags to contend with. The traveler probably doesn't know of this because they were checked through the foreign customs when he left New York. Have a porter? Yes, and he will take them to the front of the building to the interline bus system—at about a quarter a bag. The bus costs another quarter and it is not responsible for missed connections. The traveler does not know his connecting airline is the last one on the circuit and it may take half an hour on the bus, depending on the number of passengers. There appears to be no set schedule and likewise no assurance that close connections will be made. And by the time the traveler realizes this, his bags are at the back of the bus' baggage compartment. If connections are missed the airlines are helpful and will try for other reservations, probably on another airline. The tipping starts again. Also more ring-around-rosie on the bus. The traveler can't walk, not only because of distances, but also because no walkways are provided. The Eastern-Delta building has no escalators and to get upstairs is quite a jaunt up a ramp or by staircase with four doors. Try it carrying three bags.

My experience may not be typical but it is illustrative of the differences between the old and the new airport and the treatment of the departing and arriving overseas travelers. From Washington I rode National to Idlewild. My departure overseas was via TWA to Paris. My final destination was southern Spain. From Paris my flight plan called for Air France to Madrid and then Iberia.

National and TWA are in the old building so it was an easy stroll from one to the other. One porter handled the bags.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

TWA checked my bags through to the final destination although I pointed out I had no confirmation from Iberia.

At Paris the airplane was met by a free bus and passengers were taken to the transit lounge or to customs. Later another bus took me from the transit lounge to the Air France airplane. At Madrid we were taken to customs for the entry formalities. Our bags were brought into customs where we identified them and had them checked by the customs officials. They were taken away again and mine were handed over to Iberia. No handling by me. At my final destination they were treated as internal luggage.

Contrast this treatment with my reentry. I embarked at Zurich on TWA, the same airline. At check-in I was told bags could be checked only to New York. For the change from propeller to jet at Paris the same free bus system was used to move passengers around. The flight to New York was beautiful.

Then things change. First your bags are brought to one side of the customs hall where the customs' inspection is made at tables in the middle. Porters are plentiful to assist you in moving your bags across the room. But these boys are working for tips. If you elect to carry your own bags you practically have to fight to get to the racks as the boys are trying to get the paying customers through customs first.

I eventually got through and found a second set of porters waiting. "What airline boss, National? Come with me." The man rolled my bags to a bus stop. This is not the TWA area from which I departed—I could see that about a half a mile away. On the bus for a quarter. Three waits and three stops later I am at National. More porters. I have a four-hour layover and ask if it can be reduced. Helpfully the agent suggests an Eastern combination. The fourth porter and another quarter for the bus. Three stops later I decide I have bought my bags back enough times, so try carrying them. The check-in area is on the next level and no escalators. Not even directions. My luck is bad because when I get to the second level I am at the wrong end of a room as large as the Penn Station. At Eastern I am told my connections cannot be made today so I had better go back to National. This time I use a porter. Whoops! Another quarter for the bus. Finally I get back to National and get checked in. It's no longer a four hour wait as two hours were used up in airport travel. The same maneuvers could have been accomplished in the National Airport in Washington, for example, on foot in about 15 min. Is Dulles International designed like Idlewild?

With two hours to wait I decide to spend them with some acquaintances waiting for an American flight. American is the next building around the circuit, so I elect to walk. To the chapel there is a walkway but beyond that none, so back to the bus and another quarter. And another one to get back to National.

Such were my experiences. Other passengers in buses told of similar ones. It is rather frightening to think men are working to make air travel faster and more comfortable and this is the way the traveler is treated on the ground at our newest and flossiest airport.

(Name withheld by request.)

Correction

By mistake the signature was omitted from the letter "Satellite Threat" in the Oct. 24 issue of Aviation Week, p. 118, and a line from the first paragraph was repeated. The letter should have been signed: Morton I. Weinberg, Lockport, N. Y.—Ed.

Jet Noise Challenge

Testimony of Dr. Richard H. Bolt, Associate Research Director of the National Science Foundation, at the House Committee on Science and Astronautics hearing on aircraft-missile-rocket noise to the effect that "science offers no panacea for protecting communities against aviation noise" is very disturbing.

Has America's scientific talent reached the state that such a mundane annoyance as the noise made by commercial jet aircraft cannot be reduced to the point of public toleration?

Can it be truthfully said that America's scientists and engineers—the men with the brains to build ICBMs and IRBMs and conquer the sound barrier—cannot overcome the disturbing factors common to jet transports in their operations around airport communities?

If a more efficient in-flight suppressor and a turbojet engine with built-in sound abatement characteristics cannot be produced by the scientific community it is because the powers-that-be are more willing to ignore the feelings of the thousands of airport-area residents across the country than to tackle the challenge at hand.

Dr. Bolt's testimony that major advances in aviation will require nationwide planning appears to be somewhat self-serving. His firm, the acoustical consulting company of Bolt, Beranek and Newman, has reaped a financial bonanza through the simple device of making noise surveys for airport and communities—studies that have only served to confirm that a noise problem exists.

If science triumphed over the jet age noise nuisance, Messrs. Bolt, Beranek and Newman might just have to return to the university lecture halls.

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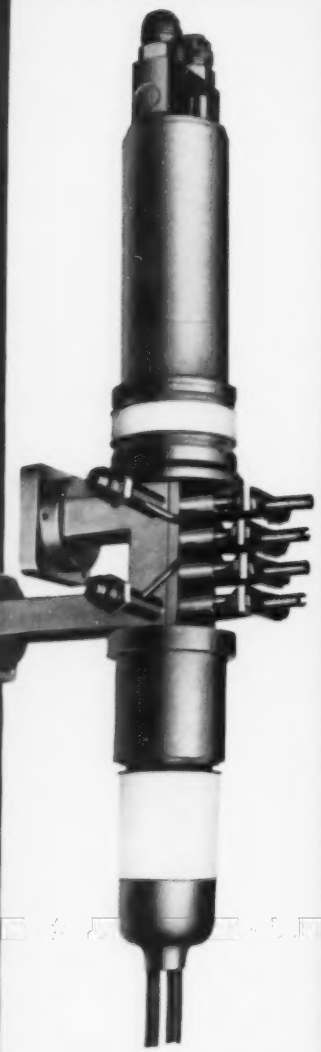

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